Tamil Nadu Nutrition Project

Volume Two

A Study Sponsored by :
The Department of Food, Union Ministry of
Agriculture and Irrigation, New Delhi

February 1983

ADMINISTRATIVE STAFF COLLEGE OF INDIA
HYDERABAD-500 049

Tamil Nadu Nutrition Project - 2

Project Leaders :
P K RAO, BALWANTH REDDY

February 1983

ADMINISTRATIVE STAFF COLLEGE OF INDIA
HYDERABAD-500 049

1983

This study was sponsored by the Department of Food, Union Ministry of Agriculture and Irrigation, New Delhi.

Printed at : Print 'N Pack Aids, Hyderabad-1

Preface

The Government of India identified the Administrative Staff College of India, Hyderabad, for a study of Tamil Nadu nutrition. Accordingly, during 1976-77, the Department of Food (Food and Nutrition Board - FNB), Government of India, entrusted ASCI with two studies, in the first phase : (i) Nutrition Aspects of Food Policy; and (ii) Integrated Nutrition Planning Models, under the Tamil Nadu Nutrition Project (TNNP). In the next phase, ASCI was asked to take up the study of (iii) Demand for Nutrients and, (iv) Integrated Nutrition Planning. The Draft Reports of these studies were submitted to the Government : those relating to the first phase in 1979, and the others in 1981. Subsequently, we invited comments and suggestions for improving the studies, and we readily received useful and critical comments from a number of specialists and officials. A project review meeting was held in October 1981, and considered these comments. It was also decided to publish the studies after necessary revisions with a view to disseminating the findings to a wider audience; it is earnestly hoped that these reports will act as stimulants for further follow-up work in this important field and help implementation of nutrition policies, especially by the State governments; this, we would consider as our reward.

During the process of our investigations, we gained immensely from many senior officials. We are especially grateful to Shri Kamala Prasad (formerly Joint Secretary, Department of Food) for the enthusiastic and constant support and appreciation of professional issues. We would like to greatefully acknowledge the co-operation we obtained from Shri S Rajagopalan (formerly Officer on Special Duty, TNNP), Shri T R Parameswaran (formerly Director. Department of Food), Dr P K Kymal (formerly Executive Director. FNB), Dr (Mrs) K K Sharma (Executive Director, FNB), Shri H D Bansal (Joint Secretary, Department of Food), and a number of senior officials of the Government of Tamil Nadu, especially Smt A Dayanand (Secretary, Social Welfare Department).

A number of professionals provided able assistance in various stages of work. Special mention must be made of Prof R Nagarajan and Shri A Thampy of the IIT, Madras Computer Centre, for arranging to process the data from the TNNP Data Bank. Among the colleagues at the College, we acknowledge the useful suggestions given by Dr Waheeduddin Khan at the stage of drafting some of the Reports. We are also grateful to : Shri K Hanumantha Rao (for the work relating to Report (I)), Ms. Mythili Ramakrishna (for the work relating to Chapter 2 of Report (ii)), Shri R Palani Velu (for a part of work relating to Chapter 3 of Beport (ii)), Shri K Vijaya Kumar (for the empirical work and testing of Models in Report (ii)), Shri G K Mitra (for the computer programming and application in Report (iii)), Shri M Surendra Reddy and Ms. B K Malleshwari (for their empirical work relating to Reports (iii) and (iv)), Shri V S A Durai, Editor. ASCI, ably edited the whole report and also co-ordinated the publication work.

The Project Leaders (P K Rao, Balwanth Reddy) shared the responsibility the former undertook part of the work, supervised empirical work, and drafted the reports, while the latter provided the overall framework and supervision.

Shri T Ganeswara Rao, Shri Sunil Nagpal Shri K Seshagiri Rao, Shri T R David, and a few others did the arduous task of typing and processing work at different stages; we are ever grateful for their co-operation.

February 1983 **P K Rao, Balwanth Reddy**

Contents

1

Demand for nutrients

1

Introduction

1. About the Report

This report is one of the two prepared under phase II of the Tamil Nadu Nutrition Project Studies conducted at the Administrative Staff College of India, Hyderabad. The other Report in this series is Integrated Nutrition Planning : A Synthesis. These reports are preceded by two reports by ASCI: i) Nutritional Aspects of Food Policy, ii) Integrated Nutrition Planning Models (submitted to the Department of Food, Government of India,in December 1979). It is envisaged that various studies dealing with different sub-systems will be combined (partly using Integrated Planning Models and partly using judgment) to yield comprehensive nutrition intervention strategies (direct intervention programmes like feeding programmes and indirect programmes affecting nutrition environment).

This Report does indicate the broad considerations and guidelines for nutrition development; these investigations are mostly based on empirical analysis. The main sources of data are: 1) TNNP Data Bank (located at IIT Madras, Computer Centre); 2) Food Balance-sheets (prepared by TNNP Office, Madras); 3) Commissionerate of Statistics, Government of Tamil Nadu.

The main objectives of this investigations in this Report are:

1. Analyse the nutrition situation in Tamil Nadu in terms of the past history of per capita consumption, prices, and incomes etc; assess the approximate nutrition gaps in different districts;

2. Assess the type and magnitude of different causal factors affecting nutrition status/nutrition intake with special emphasis on vulnerable age group—children;

3. Project the nutrition requirements based on normative considerations and also project magnitude of food and nutrition gaps;

In view of special importance of step 2, a separate supplementary Report on Child Nutrition has been drafted.

2. Approach

The main concern of this study is the analysis and estimation of demand for nutrients under different features governing the demographic and socio-economic factors for which data are available. Analytical studies on household decisions for consumption of food and non-food items in various socio-economic groups are also relevant, but the main concern here is the empirical analysis specific to Tamil Nadu situation.

Although the problem of analysis of demand for nutrients can be viewed in a strictly technical and limited perspective so as to obtain quantitatively the estimated demand for nutrients and also assess the role of different factors in affecting demand, it is useful to note that improved intake of nutrients alone may not suffice for the purpose of improved health status which is the end-product. It is desirable that the variations in health status in different sections of the society are examined in terms of nutrition and non-nutrition factors so that a broad policy could emerge in respect of relative priorities of investment for general development. We noted that there are hardly any empirical studies using reliable data on reasonable samples which enable us to assess empirically the relationships between a meaningful health index (treated as a dependent variable) and various causal factors. These causal factors could be in terms of intake of different nutrients and environmental parameters like quality

of water, air, hygiene, health facilities, etc. Also, many of these parameters themselves are functions of other activities like average income levels, skewness of income distribution, patterns of food consumption and household expenditure, relative prices of different food commodities and their nutrition content, etc. In a supplementary study on Child Nutrition we have tried to approximate the health status in terms of days of illness and attempted to explain in terms of parameters like intake of nutrients, environmental factors regarding which information is available. This exercise, however, met with only a limited success since the parameters that could be used were only a few.

It is useful to examine the available data to gain an insight into nutrition problems in Tamil Nadu. For this, the available data from TNNP Office, Madras, and Commissionerate of Statistics, Government of Tamil Nadu, Madras, are made use of. These analyses give us a perspective of nutrition status in the State and also the type and approximate magnitude of nutrition deficiencies prevalent in the State in the recent past.

Since the demand for food (through which demand for nutrients can be estimated) is a 'derived demand' in view of household consumption decisions, the conventional estimation of demand for foods in terms of prices and income may not reveal the implications of alternative policy interventions in terms of various types of programmes directly and indirectly affecting nutrition status of the population. Ideally, characteristics of food, mainly in terms of perceived tastes of consumers and nutrient characteristics have to be incorporated in a meaningful specification of demand for food. However, for empirical analysis the data limitations pose formidable problems.

Since the specification of demand functions should be amenable to integration into the broader framework of integrated nutrition planning models (developed in the earlier study dealing with these aspects), the technical features of the functional forms (most often, in linear form for computational

reasons) as well as the inclusion of explanatory variables should be broadly governed by the framework provided in the earlier study in addition to the availability of relevent data.

The transfer/substitution mechanism relating to various types of nutrition intervention programmes can be studied with a realistic formulation of utility functions at the household level in different socio-economic groups; whether and to what extent the substitution of foods take place between children and adults depends on the consequences of the net effect of nutrient consumption which, in turn, depends upon the content of relevant/ critical nutrients in the foods supplied through the intervention programmes relative to the corresponding nutrient content of the foods whose consumption is being displaced. However, such an analysis requires collection of additional data from primary sources and this is not included in these examples.

We have examined the classical and recent literature relevant to the present study. Several studies were on the technical aspects of estimation of demand systems.[1] In respect of nutrition studies, a number of investigations focused attention on the estimation of nutrition deficiencies (important few of them were reviewed critically in our previous study in the context of formulating integrated nutritional planning models), and economics of malnourishment and cost effectiveness of nutrition programmes. The later studies are useful in selecting proper categories of nutrition intervention programmes, but the intensity and extensity of development of the same can be done only with proper assessment of consumption behaviour of target population and the influences of

---

1. For example, Parks R. W. (1969) : Systems of demand equations : An emprical comparison of alternative functional forms ECONOMETRICA October 1969, 30 (4) ; Pollak R. (1970). Habit formation and dynamic demand functions, JOURNAL OF POLITICAL ECONOMY. July 1970, 78 (4) ; Anton P Barten. The Systems of consumer demand functions approach: A review. ECONOMETRICA. Jan, 1977, 45 (1).

various types of interventions, and changes in the socio-economic environment which are not directly due to intervention programmes.

In the present study, we attempted a few alternative forms for modelling and estimation that are consistent with plausible rational consumption decisions and then caliberated some of them based on statistical and behavioural merits. Our examination of the available data from secondary sources (including TNNP Data Bank) reveals that the data problems are considerable.

The other exercises in this report concern the working of the demand for nutrients based on : i) ICMR norms of nutrition requirements for different age-sex groups; and ii) projections of population in Tamil Nadu in terms of size-distribution of different age-sex groups; these requirements are transformed into food equivalents, considering (i) averege diet composition in terms of calories drawn from different food groups in the past,and(ii) food requirements based on these to meet the aggregate calorie needs estimated above. The exercises were extended to district level also. These may be called normative demands.

Seperately, using income and prices as explanatory variables, demand relations are formulated for the main food commodities; using trend projections for these variables and using the estimated demand relations, forecasts of demand have been obtained. These may be called the behavioural demands.

3. Demand Models and Literature Survey

The estimation of demand for nutrients can be viewed in a number of ways. Important among them are i) it can be estimated after converting demand for food into nutrient equivalents, (ii) nutrients be treated as inputs to "produce

goods", such as taste and health, and the consumer utility maximisation with respect to these goods can lead to derived demand functions for nutrients, iii) it can be estimated by using a simultaneous decisions model so as to incorporate the food and non-food consumption in the utility function and obtain the corresponding demand models.

The precise specification of demand models in one or the other of the above approaches should be governed by the following objective criteria : (i) the usefulness of the end-product of the estimation—whether the estimated demand relations have the structural parametres which can depict the influence on demand of various relevant influencing variables like prices, income, family size, etc., (ii) the validity of desirable theoretical properties expected out of rational decision-making process, be it household level or individual level or aggregate consumption system level, as the case may be, (iii) the statistical validity of estimated relations, whether they satisfy the desired statistical properties in order to qualify as valid models, and (iv) availability of relevant data to estimate the relations.

In practice, as many investigations in the area of estimation of demand revealed, a judicious combination of the degree of application of the above criteria is more useful than resorting to any one single criterion, particularly since the simultaneous satisfaction of all the desirable characteristics in a single model is almost an impossibility. Thus, we can formulate certain plausible demand models and only after testing for the relevant criteria, final selection among alternative models could be made. Analytical studies and empirical findings would help in assessing the impact of certain nutrition intervention programmes, for example, the general price subsidy or cross-subsidy, supplementary feeding programmes, etc.

4. Multiple Regression Models

The main purpose of these models is to assess at the household consumption level and at aggregate level for different categories of consumers the relative impact of different factors affecting the food consumption/nutrient intake so that these structural aspects could be used while designing appropriate nutrition intervention programme. Thus, various environmental factors like access to protected drinking water supply, general level of education, availability of medical facilities. etc., could be incorporated as factors affaeting the health /nutrition status, treating frequency of illness or other clinical/ anthropometric measures as proxies for the latter. The analysis in this approach depends heavily upon the availability of necessary classification of these variables in the TNNP Data Bank.

One set of multiple regression relations treat the nutrient intake of specific nutrients (calories, Protein, vitamin A and iron) as a dependent variable for each district and use explanatory variables, mainly, income, family size and composition, education, urban/rural background, social index, etc. These relations, typically multiple regression models with dummy variables, are useful in understanding the influence of different factors at the household level.

In the case of children, the priority group for nutrition development, a multi-variate analysis is carried out to explain the variations in illness in terms of nutrition and non-nutrition parameters; also, the nutrient intake by children is explained in terms of household and community level parameters.

All the relevant data are not easily available for our purpose. We have to look for additional sources apart from the TNNP Data Bank. Our sources would be the filled in questionnaire used to obtain data in latest NSS consumer expenditure survey for Tamil Nadu. Whereas the TNNP Data Bank gives cross-section data, different rounds of NSS data give

the time series for certain parameters. The basic reference unit used by the NSS is the household, the members of which will have different age-sex structures. We have to bring the total number of family members in some sort of standard. We will use adult equivalent. Consumption units are to be converted into "adult equivalents", using appropriate norms which would be borrowed from relevant study.

Engel Curves

Conventionally. Engel curves approach is used to project the demand based on certain assumptions about expenditure distribution patterns and constancy of relative prices. The Engel curve methods give us important parameters, such as income elasticities. The first step is to establish the relationship between expenditure on a specific commodity (or a group of commodities) and total consumption expenditure, that is, to find the Engel curve for different commodities.

We would attempt some of the forms given below. Each form has an underlying utility function whose maximisation leads to the specific form of demand function. Although theoretically the form (3) below is suggested often as more relevant (as it follows from direct additive utility maximisation), empirically it may not be the best valid relation for every class of consumers and for every food commodity. It is proposed to attempt the estimation of alternative relations and suggest certain forms based mainly on the economic rationale underlying each form and the statistical validity.

Let X be the household income and Y the household consumption. Different Engal Curves may be listed as below;

1. $Y = a_1 + b_1 X$ (linear)
2. $Y = a_2 + b_2 \log X$ (semi-log)
3. $\log Y = a_3 + b_3 \log X$ (double log or log-linear)
4. $Y = a_4 + b_4 (1/X)$ (hyperbolic)
5. $\log Y = a_5 + b_5 (1/X)$ (log-inverse or sigmoid)

6. $Y \quad = \quad a_6 + b_6(1/(X) + c_6 \log X$ (hyperbolic semilog)

7. $\log Y \quad = \quad a_7 + b_7(1/X) \times c_7 \log X$ (log-log-inverse).

When Engel curves are used for projections, it is assumed that (i) tastes and preferences will not change, (ii) relaative prices would remain constant, and (iii) the total consumption expenditure are distributed log normally in the base year, as well as for the year for which projections are made.

Extrapolations

For planning purposes it is felt that the estimation of nutrition gaps preferably on district-wise basis will be useful. In order to assess these gaps, we make use of the population projections available from the Tamil Nadu Planning Commission (along with age distributions). The nutrition requirements mainly in terms of calories for all age groups based on ICMR norms have been projected, until 1986-87. Also, in the case of children vitamin A and iron requirements have been projected. All these are on the basis of norms prescribed by the ICMR. The data indicating district-wise nutrition gap situation in Tamil Nadu were drawn from TNNP Data Bank. It is assumed that there are no significant changes in nutrition gaps on a district-wide basis across different districts compared to what it was at the time of the survey (about a decade ago). This could be a questionable assumption, but we do not have strong evidence to the contrary. After assessing the gaps of calories in different districts, the food equivalents of these gaps have been estimated, with the aid of information on food habits (on an average for Tamil Nadu State).

Select Literature

There are several theoretical studies dealing with various analytical issues in demand theory. It is not proposed to undertake a critical survey for the purpose of this study. A select few studies are referred here as they contain logical

foundations of some of the structural relations of demand that are estimated in the subsequent chapters.

The demand for nutrients is expressible via demand for food items, which, in turn, is based on nutrition and non-nutrition components/characteristics (Lancaster)[2] of food items. Often traditional food habits, class structure of the population under consideration and cultural factors matter as much as the nutrition content of a food item, particularly when most people do not have the complete information on the nutritional composition [3]. For this reason, we should be interested in obtaining the functional relations linking the demand for food items with various influencing parameters like income, prices, etc. One of the early major empirical works on demand for food is due to Tobin [4]. These behavioural relations would be useful in directing the consumption to meet nutritional requirements, using various policy instruments.

The demand for nutrients can be obtained via the demand for food items; in other words, it is a derived demand, given the income levels, price structure, preferences, and food taboos. In a community with inadequate exposure to nutrition education, a commodity with less nutrients may be preferred to the one with more nutrients on the basis of flavour and palatability. In general, for population with low incomes where malnutrition is most prevalent, qualitative aspects do not matter much; quantity of food per unit expenditure is the main criterion for preference. In governmental intervention programmes quantity issued and the extent of subsidy become the major determinants influencing the nutritional status of these sections of society.

2. Lancaster K. *Consumers Demand - A New Approach*. New York, Columbia University Press, 1971,
3. Prato A A, Bagali J N. Nutrition and non-nutrition components of demand for food items *American Journal of Agricultural Economics* 1976, 563-367.
4. Tobin J. A statistical demand function for food in the USA *JRSS* 1950 Vol. CXIII.

If the objective of the food policy is to supply the desi-and red/desirable nutrients to all sections of the community, knowledge of the factors determining the demand for food, in turn, the demand for nutrients is an essential pre-requisite. In other words, we should be interested in identifying the relevant policy variables that influence the demand for nutrients and the relative impact of these variables on the dependent variable, namely, the nutrient consumption of demand. However, one should note that direct estimation of demand for nutrients is a complex exercise. For example, in the study of demand for any food item, its own price and the price of the substitute will be considered, whereas in estimating the demand for nutrients, the specification of price element, in itself a difficult exercise. In general, the demand for food items will be estimated and then the demand for nutrients will be derived using information on nutrient content of different items.

Let us say there are m commodities and n nutrients under consideration. The demand for a given commodity, depends upon various economic and non-economic factors, discussed later. Once the demand vector X is estimated, the transformation

$$BX = Z$$

gives the nutritional content of the commodity vector X, where B is an X m matrix giving the nutritional composition of the items.

The crucial policy questions in practical intervention programmes is, whenever there is deficiency of one or more nutrients one would be interested in augmenting the effective consumption by proper choice of commodities. If there is a one-to-one mapping between commodity space into nutrient space one can immediately pick up the corresponding food item for augmenting a deficient nutrient. But this is not, in

general, possible. This can be answered by least cost ranking of feasible diets. However, attempts have been made in the recent past to obtain behavioural relations and a brief review of these works is presented at a latter stage. These demand relations aroused to form a set of constraints in the nutrition planning models. In estimating the functional relations for different socio-economic and demographic groups, the data requirements are considerable.

There has been vast literature dealing with consumer expenditure problems/behaviour in terms of various determinants. In general, the demand for food items will be influenced by its price, price of the substitute commodity, income of household/consumer, etc., that is, D=f (Income, price, age, sex, occupation, consumption habits...) However, functional specification of demand has to be more explicit.

It is desirable to estimate simultaneously the demand relations for various food commodities in terms of relevant explanatory variables so that the error of disaggregative single commodity demand estimation are reduced. An example of a linear form of demand function is

$$D_i^t = a_0 + \sum_{j=1}^{n} a_j p_j^t + a_{n+1} y^t$$

where p_j (j=1) are relative prices of commodities, p_j=p_i price of the commodity i, y income level. This relation is formulated for individual level. Aggregate demand function would include population factor also. In empirical estimation various other forms need to be attempted to seek estimators with reasonable explanatory power.

Demand theory based on individual consumers, is a weak guideline for empirical work using aggregate data.

However, as Lancaster[5] pointed out, it is not unknown to formulate the demand models for single individual and assume the same for the household; the validity of these specifications depends upon a number of factors. To quote Lancaster :

(i) "The observable behaviour of the household may differ from the typical behaviour of the individual in two respects, (a) the concavity properties of its demand function may differ from that of the individual, b) the efficiency properties may not conform to those of the individual".

(ii) "If the household is an aggregate of independent consumers, the concavity properties of its demand function will be weaker than those of the individual but will come closer to the individual properties as the size of the household decreases; the efficiency properties will diverge from those of the individuals with the maximum extent of this divergence declining as the size of the household decreases".

As regards the logic of specification demand function in terms of prices and income we know from theory the following:

If the utility function is weakly separable (the ratio of marginal utilities of goods in one group is independent of goods not in the group), and quasi-concave, the demand function for a commodity in particular group may be written as a function of household income the relative prices of all commodities in the particular group, and relative price indices of all other commodity groups. In this case, the demand function for the i_{th} commodity is expressed as :

$$x_i = f_i\,(Y, p, p_j/p_i) \quad (j = 1 \ldots\ldots m)$$

5. Lancastar K J. The theory of household behaviour : Some foundstions. *Annals of Economic and Social Measurement*. 1975, 4 (1).

Where Y the household income, P_j the prices of commodities within the commodity group corresponding to i, and $p = p(p_1, \ldots\ldots\ldots p_n)$ the price index of other commodity group, p(......) being homogeneous of degree one.

Although empirical estimates of Engel curves using aggregate data (rural/urban-all India) are available from other studies, the relevant parameters need to be estimated on a disaggregated basis for different expenditure classes for Tamil Nadu. Also, we are interested in the structural relations in consumer behaviour so as to assess the consequences of alternative situations arising out of changes in economic parameters (exogeneous to the system) and certain intervention policies in the food consumption system. Thus, some of the earlier studies carried out by others are of limited use only.

One of the relevant problems for empirical analysis is the estimation of the calorie-income or expenditure function. From the household consumption and expenditure surveys, calorie consumption per capita by income or expenditure class is derived since the surveys use different sample techniques and draw different sample sizes for different income groups, the variance of the error term in the calorie consumption function differs by the income class. This phenomenon called heteroscedasticity requires special estimation techniques.

One of the simple forms is

$$C_i = a + b \log Y_i + e_i$$

where

C_1 = calorie consumption per capita

y_1 = income/expenditure per capita

e_1 = error term

To maintain the variance of the error term constant for all classes, each observation is weighted by p_1 where p_1 is the proportion of sample in the i_{th} income classes, the above equation becomes

$$(\sqrt{p_i})\, C_i = (\sqrt{p_i})\, a + b\, (\sqrt{p_i})\, \text{Log}\, Y_i + (\sqrt{p_i})\, e_i$$

However, variants of this formulation incorporating additional parameters and amenable to standard estimation methods can be formulated keeping the availability of data in view; these are in vestigated inChapter 3.

The subsequent chapters of this Report deal with empirical aspects: firstly, analysis of food and nutrition situation in Tamil Nadu as observed from past data; secondly, multivariate analysis regarding determinants of intake of food and nutrients; and thirdly, projections of requirements and food gaps.

2

Analysis of Food and Nutrition Situation

In order to appreciate the background of investigations proposed in the subsequent sections of this study, it is useful to analyse the important characteristics of the nutrition situation in Tamil Nadu. For this purpose, we draw upon the extensive survey carried out in an earlier phase (1971) under the Tamil Nadu Nutrition project and stored systematically in TNNP Data Bank at the IIT, Computer Centre, Madras. We also draw upon the data available from Tamil Nadu Commissionerate of Statistics and other sources of information like TNNP Office Madras.

In the next section, the food balance-sheets prepared by the TNNP Office, Madras, are used to examine the historical trends in production and consumption of different food items, the changes in per capita availablity of calories and other nutrients during the period 1966-67 to 1978-79and the related aspects. These data are used in extrapolating the posible trend in production and availability of important food items as well as the type and magnitude of nutrition gaps that are likely to prevail in the next few years. Thus, certain tentative conclusions are also drawn based on this analysis.

The next section gives an approximate situation governing the nutrition gaps in terms of calorie need fulfilment in different districts in Tamil Nadu, categorised by different expenditure groups, based on TNNP Survey conducted during 1971.

Despite the possible limitations due to sampling errors and the time-lag in using the present analysis, the information is expected to provide a rough indication of the nutrition situation in the State as a whole, and in the districts.

2. Analysis of Food Balance-Sheet

In order to gain an insight into the dynamics of food and nutrition intake in Tamil Nadu, it is useful to examine the data pertaining to the last few years in respect of production of various food items, net availability, per capita intake/availability of important nutrients (calories, protein and vitamin A), wastages and related parameters. Much of the analysis carried out in this section is primarily based on data from food balance-sheets for the period 1966-67 to 1978–79 (prepared by TNNP Office, Madras). Relevant tables computed utilising these data are given in the Annexure to this Chapter. Summary findings are given below.

a) *Per capita net availability of food items (1966-67 1978-79)* :

Per day per capita consumption (approximated by per day per capita net availability) of different food items in Tamil Nadu for the period 1966–67 to 1978–79 is presented in Annexure I. The distribution of various food commodities in the diet across the same period is presented in Annexure II. The following observations can be drawn from the analysis:

(i) The consumption of rice has been increasing; however, wheat consumption does not show any positive trend. The consumption of ragi is nearly stationary. But the overall per capita consumption of cereals as a whole increased marginally in this period.

(ii) Among the non-cereals, only sugar consumption seems to have marginally increased. All others have been either stationary or been declining. In the latter category, it is important to mention that a disturbing trend is discernible

in the case of milk and fruits. The State which is already significantly deficient in respect of vitamin A can ill afford this situation. Considering that the common man's fruit like banana has considerable vitamin A component and considering the potential for improving milk production, urgent steps are needed to increase the production and consumption of these items. The State Horticulture department can play a vital role in this direction.

(iii) The balance at aggregate level, Tamil Nadu imports about 7.5 per cent of food items only, amounting to about 9 lakh tonnes of foodgrains. It imports about 2.3 per cent cereals, and 3.1 per cent grams and pulses compared to its own production. In the case of fruits and vegetables, the imports and exports seem to be very negligible. Considering the fact that the per capita availability of fruits is gradually declining over time, recourse to imports of various seasonal fruits (along with necessary cold storage facilities) for mitigating the short-term problems must be taken.

(iv) In quantity terms of the total food items available, the cereals account for 49 per cent, non-cereal foods available account for 34.8 per cent, and the remaining 16.6 per cent accounted by animal foods. On an average, the per capita per day requirements of food is 974 grams based on ICMR standards and the availability is only 790 grams. However, the distribution pattern of these quantities is skewed. In terms of nutrients, on an average, 2,043 k calories and 43 grams of protein per day per capita are available, as against the need of 2,242 k calories and 45 grams of protein. The fulfilment of vitamin A requirement is only 64 per cent of the need (2,545 IU).

(v) It is generally observed that if the calorie requirements are met, protein and iron requiremets are also automatically met. This is not true as far as vitamin A is concerned.

Special attention is needed in this regard either in terms of artificial doses of vitamin A or augmenting the supply of natural foods, mainly leafy vegetables, fruits, and milk.

(vi) The gains in marginal increase in per capita per day availability of food seem to be mainly due to the declining trend in the growth rate of population since 1972-73, rather than due tc any significant increase in production of food commodities.

However, that the consumption varies with changes in population, income, and prices can be seen form Annexure III.

(b) Trends in net availability and nutrition implications ;

Nutrient composition of per capita food available and proportion of nutrients derived from different food items has been summarised in Table 2. 1. The first two commcdities in order of relative percentage of contribution to caloric intake are rice (47.3 per cent), and sugar (10.2 per cent). In the case of protein, the first two are rice (41.4 per cent)), grams and pulses (12.5 per cent), In respect of vitamin A these are fruits (69.4 per cent),and milk (8.8 per cent). Considering the relative costs of different food items and their relative contribution to bringing the nutrition gap it is desirable to evolve cost effective intervention programmes affecting the consumption of different food items in the largest of population.

Tables regarding per day per capita availability of calorie, protiein and vitamin A during the period 1966–67 to 1978–79 are presented in Annexures IV,Vand VI. The variation is shown in graphs 2.1 2.2 and 2.3.

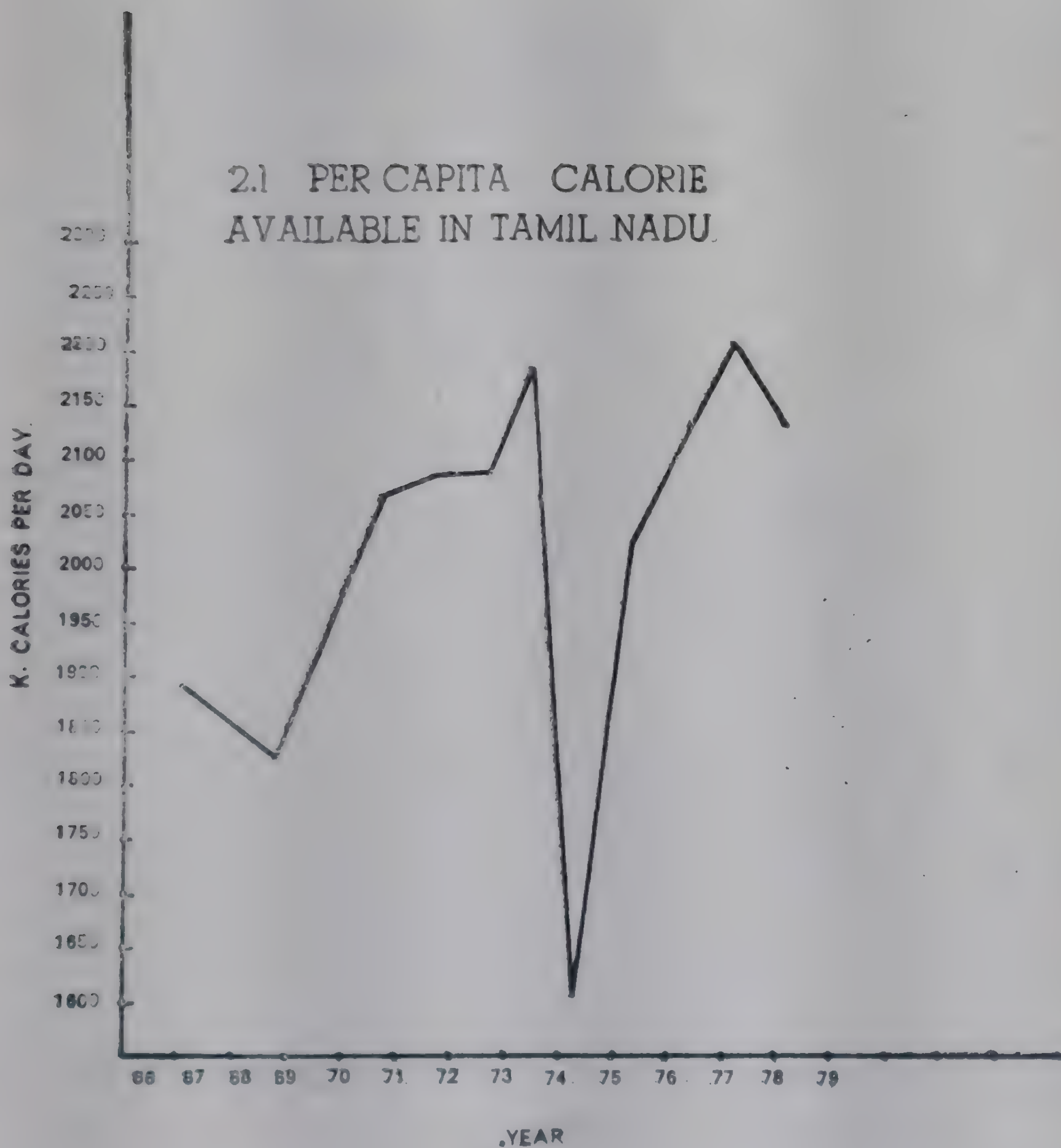
Table 2.1: PERCAPITA NUTRITION DERIVED FROM DIFFERENT FOODS IN THE FOOD SYSTEM

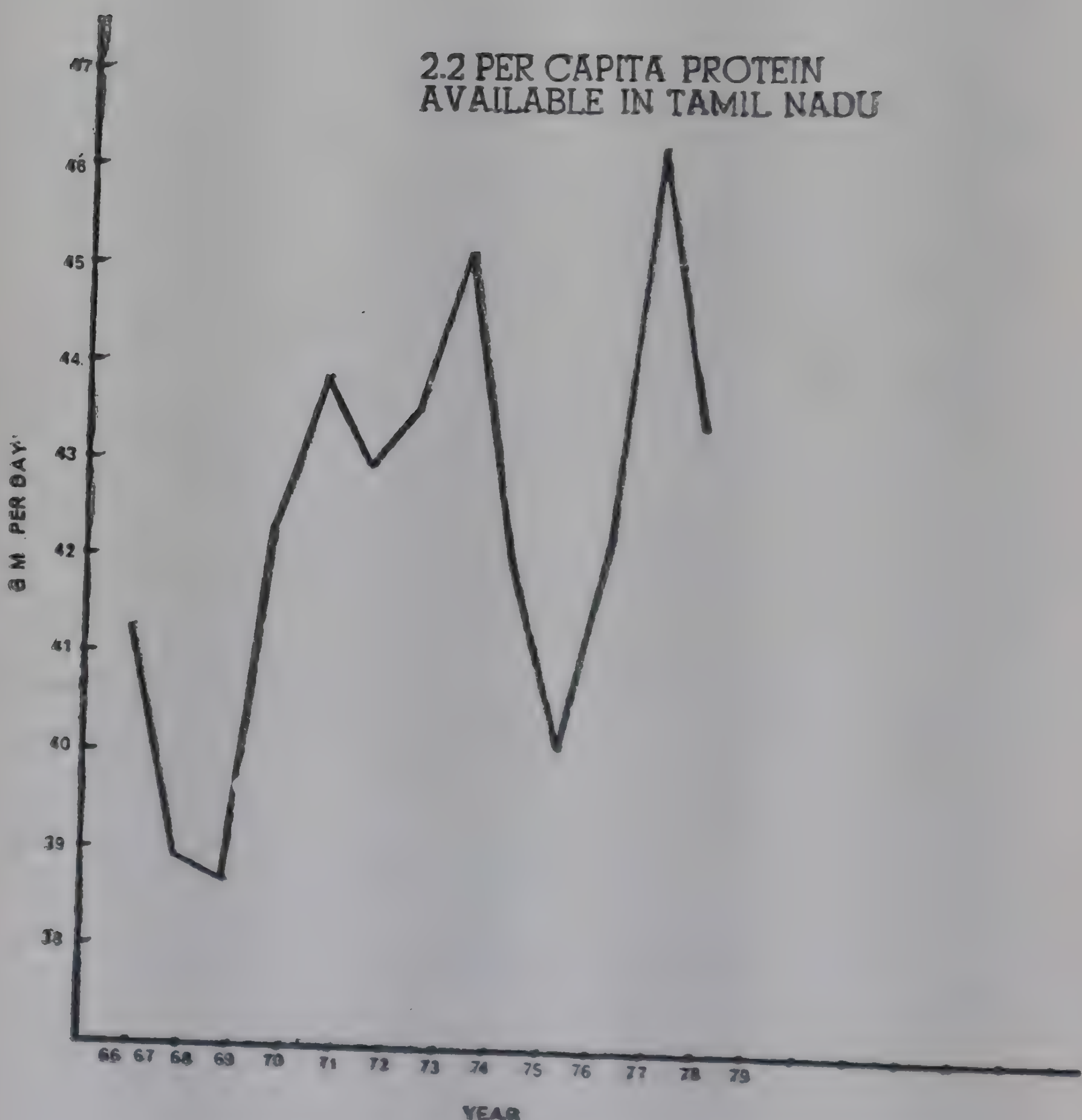
(Average for 1966—67-1978—79)

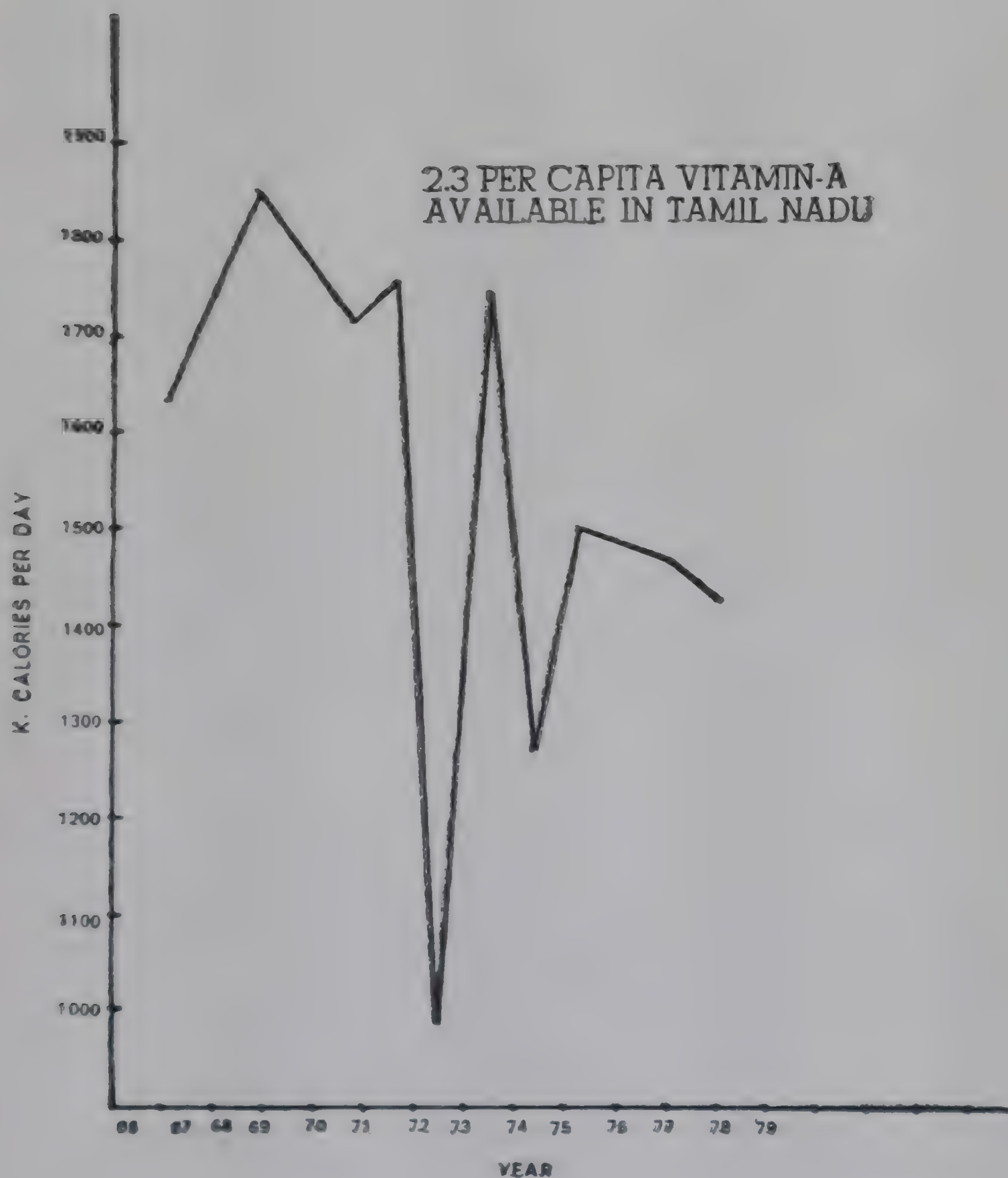
Commodity	Calorie K. Cal/day	Protein gr/day	Fats Gr/day	Vitamin-A Iv/day	Iron mg/day
Rice	970(47.3)	17.94(41.4)	1.20(3.6)	—	11(47.8)
Wheat	58(2.8)	1.97(4.5)	0.25(0.8)	—	—
Jowar	104(5.1)	3.09(7.1)	0.57(1.7)	23(1.4)	2(8.8)
Maize	5(0.2)	0.17(0.4)	0.09(0.3)	4(0.2)	—
Bajra	53(2.6)	1.64(3.8)	0.73(2.2)	33(2.0)	1(4.3)
Ragi	62(3.0)	1.39(3.2)	0.23(0.7)	13(0.8)	1(4.3)
Small millets	40(1.9)	0.92(2.1)	0.59(1.8)	—	2(8.7)
Starchy foods	47(2.4)	0.29(0.7)	0.13(0.4)	2(0.1)	—
Sugar	210(10.2)	0.17(0.4)	0.06(0.2)	110(6.8)	4(17.4)
Grams & pulses	85(4.2)	5.43(12.5)	0.80(2.4)	42(2.6)	1(4.3)
Spices & condiments	24(1.[illegible])	1.08(2.5)	0.45(1.3)	36(2.2)	—
Nuts & seeds	43(2.1)	0.82(1.1)	3.80(11.4)	1(0.1)	—
Vegetables	15(0.8)	0.79(1.8)	0.07(0.2)	66(4.1)	1(4.3)
Fruits	78(3.8)	.78(1.8)	0.26(0.9)	1132(69.4)	—
Meat	3(0.1)	0.87(2.0)	0.24(0.7)	—	—
Egg	2(0.1)	0.16(0.4)	0.17(0.5)	24(1.5)	—
Fish	13(0.6)	2.61(6.0)	0.25(0.70)	—	—
Milk	79(3.9)	3.25(7.5)	5.54(16.7)	144(8.8)	—
Oils	157(7.7)	—	17.61(53.0)	—	—
Fats	—	—	0.16(0.5)	—	—
Total	2048 (100.0)	43.37 (100.0)	33.2 (100.0)	1630 (100.0)	23 (100.0)

Figures in parenthes's indicate percentages with respect to the speciffic nutrient mentioned in the column.

Souice : Tamil Nadu Food Balance Sheets, TNNP Office, Madras.


2.1 PER CAPITA CALORIE
AVAILABLE IN TAMIL NADU
K. CALORIES PER DAY
2150
2100
2000
1800
1600
67
69
70
71
72
73
74
75
76
77
78
79
YEAR


2.2 PER CAPITA PROTEIN
AVAILABLE IN TAMIL NADU
GM. PER DAY
47
46
45
44
43
42
41
40
39
38
66
67
68
69
70
71
72
73
74
75
76
77
78
79
YEAR


2.3 PER CAPITA VITAMIN-A
AVAILABLE IN TAMIL NADU
K. CALORIES PER DAY
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
66
67
68
69
70
71
72
73
74
75
76
77
78
79
YEAR

(c) Wastage of food commodities :

(i) In quantitative terms the wastage of different food items are given in Table 2.2 over the period 1966-67 to 1978-79. In absolute magnitude, the wastage is on the increase but in percentage terms (out of total food) it is not significantly on the increase. In the category of cereals, on the whole, the rate of pencentage of wastage seems to be almost constant for the entire period.

(ii) The wastage in respect of starchy food seems to be going up. By and large, the essential features of wastage in percentage terms and per capita terms are invariant during the period of analysis.

(iii) In terms of percentage of wastage of calories per day per capita, the top three commodities are rice (57.4 percent), fruits (15.1 per cent), and jowar (8.2 per cent). This has been worked out as an average for 13 years (1966-67 to 1978-79); the percentage are relative to the total calories wastage across different food commodities. In respect of protein, the corresponding figures are rice (42.3 per cent), vegetables (15.5 per cent), and jowar (10 per cent).

(iv) It is estimated that, on an average, about 86 k calories) and 2 gms of protein per day per capita are wasted as can be seen in Annexure IX. The percentages of wastage of calories and protein from different food commodities are presented in Annexures VII and VIII. Although it is practically impossibe to eliminate completely the wastage component it is possible to reduce it. It is very useful to investigate the social cost-benefit implications of varying investment patterns for reducing wastage at different levels; from observations it is possible to identify the relative priorities in intervention in food processing systems in reducing the wastages. It emerges that improved food processing and preserving methods, especially in the case of perishables like fruits are likely to be socially profitable and might justify investment in this direction for reducing wastage.

(v) The value of food items wasted on an average works out to about Rs. 350 crores at current prices. Even if 10 per cent of this loss is invested by spreading the network of community canning and food preserving centres with an emphasis on processing seasonal fruits, it would greatly help the Tamil Nadu nutrition programme, both in reducing wastages and in reducing the nutrition gap in respect of vitamin A, apart from giving the benefit of improved and increased consumption of food items to the society.

In addition to the analysis of composition of average food basket (for the period 1966-67 to 1978-79) in terms of nutrients derived from different food items given in Table 2.1), it is of interest to examine the implications of a given percentage rise in calories on the other nutrients. As an illustration of this, Table 2.1 is used to arrive at Table 2.3 which depicts the implications of a 10-per cent rise in calorie intake on vitamin A and iron. The Table indicates that there is less than corresponding rise in vitamin A and significantly higher rise in the intake of iron, given the food habits. Similarly, other implications in respect of the intake of other nutrients can be worked out, corresponding to different levels of rise in calorie intake.

3. Analysis of District-wise Expenditure, Group-wise Calorie Intake and Deficiency

Using the information from TNNP Data Bank, a summary statement is prepared, indicating the number of households survered in each category of expenditure group in each district, the average calories consumed per household, the number of households where calorie requirements are fully met out of the sample households surveyed, the number of households with 80 per cent (as absolute minimum) fulfilment of calorie requirements and average percentage fulfilament of calories among households. This is presented in Annexure X.

Table : 2.3 : PERCAPITA NUTRIENT INPUTS FROM DIFFERENT FOODS WHEN CALORIES ARE INCREASED BY 10 PER CENT

Commodity	Calorie K. Cal/day	Net result of 10 % increase in Cals, K. Cal/day	Food equivalents for 10% increase in Calories (net result) grams/day	Vitamin A IU/day	Iron mg/day
Rice	970(47.3)	1067	308	—	12(41.5)
Wheat	58 (2.8)	64	19	9(0 5)	2(6.9)
Jowar	104 (5.1)	114	33	26(1.4)	2(6.9
Maize	5 (0.2)	6	2	3(0.2)	—
Bajra	53 (2.6)	58	19	34(1.9)	1(3.4)
Ragi	62 (3.0)	68	21	15(0.8)	1(3.4)
Small millets	40 (1.9)	44	22	—	1(3.4)
Starchy food	47 (2.4)	52	38	8(0.4)	—
Sugar	210(10.2)	231	58	161(9.0)	6(20.8)
Grams & pulses	85 (4.2)	93	27	32(1.8)	2(6 9)
Spices & condiments	24 (1.2)	26	9	48(2.8)	1(3.4)
Nuts & seeds	43 (2.1)	47	11	2(0.1)	—
Vegetables	15 (0.8)	17	50	87(4.9)	1(3.4)
Fruits	78 (3.8)	86	1:0	1215(67.9)	—
Meat	3 (0.1)	3	3	1	—
Egg	2 (0.1)	2	1	22(1.2)	—
Fish	13 (0.6)	14	23	—	—
Milk	79 (3.9)	87	74	127(7.1)	—
Oils	157 (7.7)	173	19	—	—
Fats	—	—	—	—	—
Total	2048	2253	877	1789 (100.0)	29 (100.0)

Figures in brackets indicate percentages

We confine our attention only to calorie aspect, as this is the most important indicator of nutrition intake at the aggregate level for the household. However, the TNNP Data Bank permits us to make use of the information in respect of various other important nutrients also. The district-wise summary statement is presented in the next few pages.

The following observations are made from these tables:

1. The lowest reported intake of calories in the lowest expenditure group (Rs.0-8) is observed in Nilgiris district, followed by Madras. The estimated percentage fulfilment of calorie requirements in these districts are 14.8 and 17. 5, respectively. These figures are unusually low for the continued survival of human beings. One possible interpretation for such low numbers could be that since the data are based on a 24-hour recall method and a 30-day recall method used in the survey analysis at the time of gathering information from households, the reported intake need not be representative of an average intake over a longer period which could be much higher in any given year. Also, a number of non-traditonal food items (non-traditional with respect to aggregate consumption for the State as a whole) could be unreported in the survey. It is unrealistic to expect that the sample coverage with very small samples in this expenditure group across districts can be anywhere near representative sample. Therefore, no significant inferences can be made based on this information. The highest percentage fulfilment of calorie requirement in the same expenditure group is reported from Salem district, followed by Tiruchi district. The estimated precentages are 45 and 42, respectively. The sample sizes of household covered are again small and it is doubtful if these numbers could be representative of the intake in this expenditure group.

2. In respect of the next expenditure group, (Rs.8–81), the percentage calorie fulfilment varies from 41 (in the case of

Madras district) to 77 per cent (South Arcot district). The urban effect on food prices and intake probably is responsible for the lower percentage fulfilment of calorie in this expenditure group in the case of Madras district. The fact tha the considerably large samples of households (174) from Madurai district and Chengulput district (covering 57 households in this district) expenditure group indicating nutrition fulfilment of the order of only about 55 per cent supports further the hypothesis of adverse impact of urban nature of households on calorie intake in this expenditure group. The estimated percentage fulfillment of calcrie is low in the cases of Nilgiris (43), and Kanyakumari (52) districts also. But the explanation seems to rest on the low production of food commodities in these districts.

3. The next expenditure group (Rs. 18–28) is probably on the threshold of poverty : some households fulfilling the necessary calorie requirements and some failing short of it. The percentage fulfilment varies from 67 (in case of Nilgiris) to 129 (in case of Tanjavur).

4. Referring to the next expenditure group (Rs.28–55), the only district where this expenditure does not seem to be adequate for providing 100 per cent fulfilment of calorie requirements is Madras district. This could again be possibly due to the urban nature of the households. However, based on the criterion of fulfilment of 80 per cent (with reference to ICMR norm) requirement of calories, all the district qualify on an average in this expenditure group.

5. Households with expenditure above Rs. 55 have been categorised separately for each district and percentage calorie fulfilment estimated. These percentages vary from 124 (in case of Madras district) to a surprising 949 (in case of Salem district). Whereas the size of the sample is 53 households in the case of Madras district, the corresponding number is only 2 in the case of Salem district. It can be inferred that the estimated percentage fulfilment of calories

may be reasonably approximate to reality in the case of Madras district but not so for Salem district. It is highly unlikely that there can be an intake of the order of nine times the requirement in any household. High percentages are noticed in a few other districts also like Tanjavur and Tirunelveli. These may have to be discounted due to possible errors arising from small sample size and the possibility of considerable wastage of foods in the high income groups.

The analysis contained in this chapter is indicative of the broa featurers of food and nutrition situation (historically and relatively) currently in Tamil Nadu. Some of these observations are also indicative of the quality of information available for further analysis, carried out in the subsquent chapters.

Annexure VI

Per Capita Availability of Vitamin - A in Tamil Nadu (1966-67 to 1978-79)

(I.U./day)

	66-67	67-68	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	Average
CEREALS														
Jowar flour	27	25	23	28	24	20	22	23	16	28	31	27	7	23.2
Bajra flour	42	33	38	35	33	28	26	34	13	31	42	34	41	33.1
Ragi flour	14	14	12	12	14	13	11	12	—	18	12	14	14	12.3
NON-CEREALS														
Sugar	77	91	143	97	76	87	104	160	147	107	116	126	102	110.2
Grams&Pulses	43	35	42	37	45	44	43	47	33	38	47	44	45	41.8
Spice & condiments	32	45	27	31	45	44	38	38	27	45	44	23	27	35.8
Vegetables	59	66	61	60	51	62	68	68	76	72	67	72	71	65.6
Fruits	1290	1290	1335	1341	1293	1331	624	1333	908	1028	985	977	977	1132.1
Eggs	24	24	22	22	22	22	22	22	24	24	25	27	28	23.7
Milk	157	156	85	154	150	150	149	148	146	146	145	145	144	144.2
Total	1665	1779	1888	1817	1753	1801	1007	1790	1290	1537	1514	1489	1456	1598.9

Source : Tamil Nadu Food Balance-sheets, TNNP Office, Madras.

Annexure VII

Wastage of Calories in Tamil Nadu: Percentages Across Different Commodities

Food Item	1966-67	67-68	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	Average of 13 years
Cereals														
Rice	55.3	57.4	53.4	54.8	60.8	61.2	62.8	60.5	53.4	57.8	50.8	58.2	60.1	57.4
Jowar	9.80	9.5	9.0	10.2	8.0	6.5	7.1	6.9	7.3	9.6	11.5	8.9	2.6	8.2
Maize	0.24	0.3	0.24	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.5	0.4	0.5	0.4
Bajra	4.10	4.0	4.0	4.1	3.5	2.9	2.7	3.4	1.8	3.4	5.1	3.5	4.5	3.6
Ragi	1.81	1.7	1.7	1.5	1.6	1.4	1.2	1.3	0.3	2.0	1.6	1.6	1.7	1.4
Small millets	1.11	1.0	1.0	1.0	0.9	0.8	0.7	0.6	0.4	0.7	0.8	0.7	0.6	0.8
Non-Cereals														
Starchy foods	2.40	2.8	3.3	2.9	2.5	2.7	2.9	3.0	4.3	4.7	5.0	4.4	5.5	3.7
Grams & Pulses	1.60	1.7	1.8	1.5	1.6	2.2	2.2	2.2	1.7	1.4	2.1	2.0	2.3	1.9
Spice & Condiments	3.1	—	2.9	3.0	3.5	3.5	3.2	3.2	3.3	3.2	3.9	2.2	3.0	3.1
Vegetables	4.2	4.8	4.5	4.2	3.5	3.7	4.2	4·2	6.1	4.5	4.5	4.3	4.5	4.4
Fruits	16.4	16.8	18.2	16.4	13.7	14.7	12.6	14.2	18.0	12.1	14.2	13.7	14.7	15.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100·0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Tamilnadu Food Balance Sheets, TNNP Office Madras.

Annexure VIII

Wastage of Proteins From Different Food Commodites in Tamil Nadu : Percentage Across Different Commodities

Food Item	66-67	67-68	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	Avg. of 13 Years
CEREALS														
Rice	41.1	42.8	39.2	40.4	45.8	41.2	46.7	44.0	38.8	42.1	36.2	43.2	43.9	42.3
Jowar	11.8	11.3	10.6	12.1	9.8	7.9	8.5	9.7	8.6	11.2	13.2	10.6	3.5	9.9
Bajra	5.3	5.1	5.1	5.3	4.6	3.8	3.5	4.3	2.3	4.3	6.3	4.5	5.6	4.6
Ragi	1.6	1.6	1.5	1.3	1.3	1.3	1.1	1.1	0.3	1.8	1.3	1.4	1.4	1.3
Small millets	1.2	1.2	1.1	1.1	1.1	0.8	0.7	0.7	0.4	0.7	0.8	0.7	0.7	0.9
NON-CEREALS														
Starchy Foods	3.3	3.8	4.5	3.9	3.4	3.8	4.0	4.0	4.0	5.7	6.3	6.6	6.0	7.2
Grams & Pulsee	4.4	4.6	5.0	3.9	4.4	6.1	5.9	5.8	4.5	3.7	5.4	5.4	6.2	5.0
Spices & Condi-ments	5.2	—	4.9	6.0	6.0	5.9	5.5	5.4	5.4	6.1	6.4	3.6	5.0	5.0
Vegetables	15.1	18.1	15.9	15.8	13.5	13.6	15.2	15.2	18.0	15.2	14.2	14.9	16.4	15.5
Fruits	10.8	11.1	11.8	10.7	9.4	9.9	8.3	9.1	11.6	7.8	8.9	9.1	9.5	9.8
Total (Approximate)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Tamil Nadu Food Balance Sheets.

Annexure IX

Percapita Wastage of Calories and Protein

	Total Calorie Wastage (Million K.Cal)	*K. Cal/Percapital day	Total Protein Wastage (Million of)	*Im/ Percapita/day
66-67	1140782	84	25161	1.8
67-68	1106008	79	23604	1.6
68-69	1102044	77	24433	1.7
69-70	1215913	83	26350	1.8
70-71	1378157	92	30189	2.0
71-72	1447586	94	31800	2.1
72-73	1474727	95	32440	2.0
73-74	1526413	95	74380	4.6
74 75	1091015	66	24244	1.5
75-76	1492196	89	33702	2.0
76-77	1374929	80	32140	1.8
77-78	1625262	93	36088	2.1
78-79	1534193	86	33997	1.9
Avg.	1346863	86.0	33002	2.1

*. Additional amount of Calorie / Protein that can be consumed if the wastage is avoided completely

Annexure–X

District-wise expenditure-Group-Wise calorie intake and deficiendy.

District/ Expenditure group	0-8	8-18	18-28	28-55	55 +
Madras					
a	2	58	109	132	53
b	33.95	91.90	133.67	207.62	325.29
c	75.08	193.89	318.38	339.01	400.63
d	0	1	6	27	34
e	0	1	16	71	47
f	17.5	41.3	75.1	86.1	124.2
Chingleput					
a	5	57	88	112	15
b	52.40	84.62	123.79	157.11	276.16
c	123.60	222.96	337.59	345.00	335.17
d	0	0	14	49	11
e	0	5	39	83	14
f	23.3	55.5	90.5	107.5	124.8
North Arcot					
a	9	132	150	129	22
b	45.02	82.23	113.83	144.49	450.66
c	166.25	264.22	335.66	390.12	776.47
d	0	10	54	90	21
e	1	24	101	112	21
f	34.1	65.8	98.2	133.1	286.8
South Arcot					
a	7	97	40	32	7
b	34.00	37.82	106.62	149.58	576.72
c	143.18	147.03	229.21	482.82	525.92
d	0	12	18	24	7
e	0	19	25	29	7
f	34.9	77.2	96.1	323.5	206
Dharmapuri					
a	0	35	37	40	12
b	0	82.87	112.33	168.84	263.29
c	0	231.94	271.98	350.44	513.22
d	0	2	6	26	11

District Expenditure group	0-8	8-18	18-28	28-55	55+
e	0	4	18	33	11
f	0	60.2	81.1	111.4	182.6
Salem					
a	3	40	73	43	2
b	53.96	75.72	111.30	154.09	392.15
c	242.59	236.54	289.43	303.60	2686.48
d	0	16	15	27	2
e	0	10	48	35	2
f	44.9	66.1	83.9	104.1	949.0
Coimbatore					
a	7	79	109	168	39
b	39.88	80.27	113.08	164.38	404.88
c	119.79	224.42	301.39	369.59	487.77
d	0	2	24	101	33
e	0	12	48	131	37
f	30.2	64.3	89.3	113.5	172.5
Nilgiris					
a	1	15	53	74	15
b	45.8	90.31	130.61	171.96	199.47
c	68.72	169.31	269.52	326.55	322.41
d	0	0	0	37	14
e	0	0	10	61	14
f	14.8	43.3	67.4	100.5	145.0
Tiruchirapalli					
a	12	123	120	55	7
b	35.18	71.53	91.47	126.70	307.18
c	155.57	264.54	368.54	476.30	693.74
d	1	22	57	41	6
e	1	45	83	46	6
f	41.7	73.1	124.2	192.8	260.1
Madurai					
a	29	174	173	129	26
b	35.75	68.10	111.10	166.70	408.53
c	143.26	188.14	327.68	403.89	715.24
d	1	6	27	67	23
e	2	22	69	100	23
f	37.9	54.5	94.9	128.6	272.7

District Expenditure group	0—8	8—18	18—28	28—55	55+
Thanjavru					
a	6	103	157	91	128
b	34.40	80.07	110.96	146.05	359.08
c	103.66	266.37	435.52	579.87	1242.97
d	0	16	75	74	27
e	0	24	105	84	27
f	28.9	66.8	129.4	202.4	449.7
Ramanathapuram					
a	5	54	71	45	5
b	35.44	78.75	108.91	161.64	167.29
c	140.01	217.03	267.50	401.23	268.03
d	0	3	15	27	4
e	0	6	32	39	5
f	31.5	54.8	80.0	125.4	174.6
Tirunelveli					
a	6	81	132	89	17
b	33.73	75.11	106.62	171.65	286.87
c	118.61	211.46	218.55	447.86	873.51
d	0	6	35	54	16
e	0	15	72	70	17
f	27.1	58.8	86.7	134.9	394.7
Kanyakumari					
a	1	44	43	48	12
b	11.00	81.28	117.10	185.44	441.92
c	71.72	213.09	302.09	473.12	899.43
d	0	1	7	28	11
e	0	2	19	42	12
f	23.7	52.1	81.9	130.5	234.9

a : Number of Households

b : Average for Household expenditure on food in Rs.

c : Average calaries per Household purchased in 000' cals

d : Number of Households with calories requirement fully met

e : Number of Households with 80% fulfilment of calories

f : Percentage calories requirement satisfied

3

Determinants of Consumption of Nutrients

1. Socio-Economic Factors

If health is the end-product of inputs like nutrition, the determinants of health can be classified into two groups: i) the household's marketable endowments, and ii) the characterestics of the household's environment that affect the health. These can also be classified in terms of socio-economic factors which affect (i) intake of nutrients, (ii) proper absorption of the nutrients. For policy and operational purposes it is useful to categorise the influencing parameters in terms of those which are or are not amenable to control (intervention) by public authorities at the household level as well as community level. Several facilities like provision of protected water supply and improved sanitation can be treated as public goods affecting favourably the health environment for any specific level of intake of nutrients.

For the present purpose, we would like to examine the determinants of intake of specific nutrients, such as calories, protein, vitamin A and iron which are considered relatively critical for the overall nutrition development. The socic-economic parameters and also certain environmental factors which are applicable at the household level are treated as the eligible set of explanatory variables/causal factors. The choice of these is mainly governed by the availability of necessary data from the TNNP Data Bank. Thus, we have selected food (and total) expenditure, education level, composition of the household in terms of number of adults and children, occupation, rural/urban location, vegetarian/non-vegetarian food consumption habits and caste as possible explanatory variables.

Both linear and non-linear specifications of possible linkages with multiple parameters are attempted. The main limitation of these investigations is that since the data base is drawn from a cross-section survey, and also since the sampling procedure was not evolved with a view to isolating the relative effect of different supplementary feeding programmes administered by the governmental/voluntary agencies, we will not be able to assess the relative roles of various socio-economic parameters vis-a-vis feeding programmes. Separate supplementary analysis based on fresh field data will be useful for drawing inferences regarding the nutrition intervention programmes.

2. Analysis of Determinants of Intake of Nutrients

(a) *Summary of Assesement of Irrelevant Explanatory Variables*:

We hypothesised that the social characteristics may be grouped under three-way categorisation of castes: backward castes; upper castes; and others, making use of information available from the Directorate of Social Welfare and raw data drawn from the TNNP Data Bank. Several multi-variate relations were formulated and attempted to be estimated in terms of these and other variables. It turned out that these variables are not only insignificant but are affecting the entire process of estimation of parameters with terrible high Standard Error (SE) of the coefficients corresponding to these variables in all forms of regression equations. This situation leads us to observe that the caste variable is thoroughly insignificant in explaining any variation in consumption of nutrients. This could probably be attributed to the fact that several castes classified under backward class need not strictly be economically backward. Also, the possibility of multi-collinearity among explanatory variables in all the estimated rela ions is not ruled out. The dependent variables which were attempted to be explained in terms of caste variables, education parameters, and other explanatory variables like food expendi-

ture, rural/urban location, etc., were mainly consumption of protein, calorie, iron and vitamin A at the household level (are in per capita terms). The different combinations of explanatory variables attempted are listed below:

1 Caste, education, rural or urban, total food expenditure, number of adults and number of children
2 Caste, education, rural or urban, total food expenditure
3 Caste, education, total food expenditure
4 Caste, education, rural or urban, $\log_{10}$ and reciprocal of total expenditure
5 Caste, education, per capita expenditure
6 Caste, education, total expenditure
7 Caste, education, rural or urban, per capita expenditure
8 Caste, education, rural or urban, number of adults, number of children, total expenditure
9 Caste, education, rural or urban, total expenditure
10 Caste, education, total expenditure
11 Caste, education, rural or urban, $\log_{10}$ and reciprocal of food expenditure
12 Caste, education, per capita food expenditure
13 Caste, education, total food expenditure
14 Caste, education, per capita food expenditure, rural or urban

Also, attempts were made to explain the behaviour of consumption of vitamin A in terms of the following combinations of parameters:

1 Log_{10} of total expenditure, reciprocal of total expenditure
2 Log_{10} of total food expenditure, reciprocal of total food expenditure

3 Education, caste, per capita expenditure

4 Education, total expenditure

5 Education, per capita food expenditure

6 Total food expenditure, education

None of the above combinations of explanatory variations led to any significant valid statistical relations. However, a few other combinations could explain part of the behaviour of vitamin A consumption and these are discussed in the subsequent sections of this Chapter.

b) Consumption of Calories:

Several linear and non-linear functional forms have been utilised for analysing the determainants of intake of calories. Select few estimated relations are given in the subsequent pages. The observations emerging from the estimated relations are summarised in the subsequent paragraphs.

The food habits in terms of vegetarianism and non-vegetarianism of the households did not have any significant impact in determining the calorie intake. Also, the family composition in terms of number of adults and number of children did not indicate any significant impact on calorie intake. In order to examine the possibility of analysing the impact of parameters at the household level, which are not directly accounted through food expenditure, the total household expenditure was taken as an explanatory variable for the purpose of analysing intake of calories. This exercise, although gave statistically significant results, has relatively lass explanatory power (R_2) compared to the statistical relations estimated using food expenditure as an explanatory variable. In other words, higher household budget on food and non-food items does not necessarily imply higher budget on foods leading to increased intake of calories. This phenomenon could either be due to change in relative proportion of expenditure in

favour of non-food items with increase in total expenditure and/or shifts in consumption for items of composition of food basket.

The education parameter as classified in TNNP Data Bank (codes A to F, G to K, L to T) did not appear to have any significant positive impact on intake of calories. On the other hand, this variable (pertaining to education of standard 5th and above of the household) resulted in either insignificant impact or negative impact on the consumption of calories. The explanation could be in terms of the relatively urban nature of the households when the education level falls in the above category, since in this case there is no significant increase in household income compared to relatively uneducated households. This explanation is further supported when we examine the calorie intake behaviour in terms of the dummy parameters indicating rural/urban location of the household. The impact of the occupational parameters classified in terms of working class/other category households seem to be only marginally significant.

Some of the relevant estimated equations are given at the end of this section. As expected, the household food expenditure is a major determinant of intake of calorie. The equations (2) and (4) indicates the relative roles of food expenditure and education parameters and also those to food and total expenditure parameters. The explanatory power when food expenditure and education variables are used as explanatory variables is significantly higher than in the case of the estimated relation (4) where food expenditure is replaced by total expenditure.

The various estimated relations given at the end of this sub-section are very useful for interpreting the relative role, especially of food expenditure parameter, where as the equations are expected to be representative of the typical consumption for the study as a whole, ignoring the inter-district variations in consumption behaviour, on an average, these are expected to give reasonably good assessment of implications

of changes in explanatory variables. Since most of the explanotory variables are dummies, the possible choices governing the behaviour of these variables are only two in each case. However, a continuous variable, mainly food expenditure, can be used via its coefficient for assessment of implications on intake of calories. An exercise using average State income per capita at 1970–71 prices, and altering it by 5 per cent rise, indicated that the per capita increase in calorie consumption per day could be of the order of 70 K calories. It must be noted that for every increase by a rupee (at 1970-71 prices) in food expenditure at the household level, the improvement in calorie consumption for the household is around 2,300 K calories (based on the coefficient of Z_5 in equation (1)). This impact applies to households categorised in terms of rural/urban location, occupation and expenditure. If we take a different cross-section of the population classified in terms of level of education and expenditure (as is done in case of equation (2)). the relative impact of additional one rupes (at 1970-71 prices) food expenditure results in increased intake of 2,500 K calories for the household. It may also be noted that the corresponding increase in calorie intake by the household per additional rupee expenditure with respect to total expenditure (food and non-food) results in increased calorie intake of the order of 2,000 K calories as can be seen from equations (3) and (4).

The following notation is used in addition to the symbols stated in Chapter 3.

Z_1	:	Total consumption of protein
Z_2	:	Per capita consumption of protein
Z_3	:	Total consumption of calorie
Z_4	:	Per capita consumption calorie
Y_5	:	Total iron consumption
Y_6	:	Per capita iron consumption

A. Consumption of Calories

1. $$Z_3 = 23051.7 + \underset{(9.34)}{2324.6}\, Z_5 - \underset{(1.73)}{34440.6}\, Z_9 + \underset{(0.57)}{10363.8}\, X_{18}, \quad R^2 = 0.612$$

2. $$Z_3 = 18649 + \underset{(9.5)}{2504.1}\, Z_5 - \underset{(1.4)}{25999}\, Z_7 - \underset{(0.85)}{25998}\, Z_8, \quad R^2 = 0.606$$

3. $$Z_3 = 10879.4 - \underset{(2.54)}{54784.2}\, Z_9 + \underset{(8.0)}{1988.8}\, X_{14} + \underset{(0.82)}{16229}\, X_{18}, \quad R^2 = 0.540$$

4. $$Z_3 = 4490.8 - \underset{(1.77)}{38767.8}\, Z_7 - \underset{(0.37)}{12756}\, Z_8 + \underset{(7.63)}{2170.7}\, X_{14}, \quad R^2 = 0.500$$

5. $$Y_{10} = 4.16 + \underset{(6.36)}{0.63}\, X_3 - \underset{(1.96)}{8.49}\, X_4, \quad R^2 = 0.512$$

6. $$Y_{10} = 4.1 + \underset{(7.04)}{0.7}\, X_3 - \underset{(2.3)}{9.47}\, X_4 + \underset{(0.05)}{0.01}\, X_{12} + \underset{(0.32)}{0.01}\, X_{13}$$
$$- \underset{(1.23)}{0.03}\, Z_7 - \underset{(0.38)}{0.01}\, Z_8 + \underset{(6.83)}{0.14}\, X_{18}, \quad R^2 = 0.575$$

7. $$Y_{10} = 3.94 + \underset{(7.02)}{0.74}\, X_3 - \underset{(1.64)}{7.12}\, X_4 + \underset{(0.05)}{0.01}\, X_{12} + \underset{(0.62)}{0.02}\, X_{13}$$
$$- \underset{(2.11)}{0.05}\, Z_7 - \underset{(1.92)}{0.05}\, Z_8, \quad R^2\ 0.524$$

Y_7 : Total vitamin A consumption
Y_8 : Per capita Vitamin A consumption
Y_9 : log 10 of total protein consumption
Y_{10} : log 10 of total calorie consumption
Y_{11} : log 10 of total consumption iron
Y_{12} : log 10 of total consumption vitamin A
X_3 : log 10 of total food expenditure
X_4 : Reciprocal of total food expenditure
X_{16} : log 10 of total expenditure
X_{17} : Reciprocal of total expenditure
N_1 : Number of adults
N_2 : Number of children

(c) Consumption of Protein:

The behaviour of education parameters in influencing the consumption of protein continues to be the same as in the case of calories and the explanation need not be different from what was offered earlier. Similarly, the positive impact (though statistically not very significant) of the occupational parameter (working class) in favour of the higher intake of protein is noticeable from the empirical relations. The relative contributions of education parameters is also mostly captured when they are replaced by rural/urban location used as a dummy variable. Also as expected, the food expenditure turns out to be the most important explanatory variable among all the variables attempted. The best explanatory power of household consumption of protein was offered in terms of food expenditure, rural/urban location, and occupation classification (working class/others). Due to lack of homogeniety and proportionateness within the household in consumption of protein, the estimated relations explaining the behaviour of per capita consumption of protein have less explanatory power compared to those for the household as a whole. Relevant estimated ıelations are presented at the end ihftos sub-section.

As experienced earlier, total expenditure of the household does not offer any better explanation of consumption of protein than food expenditure. The logarithmic behaviour of protein consumption was best explained in terms of log 10 of total food expenditure, reciprocal of food expenditure, vegetarianism/non-vegetarianism, education parameters and rural/urban location. Equation (1) from the set of relations presented at the end of this section indicates the relative roles of different factors. Clearly, vegetarian households taken as an explanatory parameter does not favourably influence protein intake, whereas non-vegetarian households do–possibily due to higher concentration of brobein in the diets consumed by the latter category. The multicollinearity between education parameters and rural/urban dummy parameter appears to be of less consequence although not entirely ruled out. The difference in statistical explanatory power (R^2) between relations (1) and (2) is indicative of the relative impact of rural/urban parameter over and above the impact of education parameters. In compirisen of equation (1) and (3), it is clear that the role of food habits is reletively minimal in determining the protein consumption behaviour.

From the relations governing the behaviour of Z^1 it may be noticed that the approximate contribution of additional one rupee (at 1970-71 prices) food expenditure per household is around 60 gms of protein whereas corresponding contribution from a rupee increase in total expenditure is of the order of 50 gms.

d) *Consumption of Vitamin A and Iron ;*

The explanations governing the consumption behaviour of litamin A ganerally are seen to be much more complex than in case of most other nutrients. This could be due to the heterogeneity in the availability of this nutrient acrcss different commodities (unlike calories/protein), given the typical food basket composition. None of linear multi-variate formulations lead to any useful statistical relationships. The estimated select non-linear relationships are given at the end

B. Consumption of protein

1. $$Y_9 = 2.344 + \underset{(8.887)}{0.751}\ X_3 - \underset{(\ 2.32)}{8.158}\ X_4 + \underset{(0.539)}{0.088}\ X_{12} + \underset{(3.078)}{0.095}\ X_{13} - \underset{(2.257)}{0.04}\ Z_7 - \underset{(0.816)}{0.017}\ Z_8 - \underset{(8.928)}{0.154}\ Z_9,\ R^2 = 0.655$$

2. $$Y_9 = 2.170 + \underset{(8.566)}{0.792}\ X_3 - \underset{(1.445)}{5.547}\ X_4 + \underset{(0.381)}{0.068}\ X_{12} + \underset{(3.22\ )}{0.108}\ X_{13} - \underset{(3.258)}{0.062}\ Z_7 - \underset{(2.721)}{0.062}\ Z_8,\ R^2 = 0.585$$

3. $$Y_9 = 2.869 - \underset{(1.607)}{0.067}\ Z_7 - \underset{(1.221)}{0.084}\ Z_8 - \underset{(1.708)}{0.077}\ Z_9 + \underset{(1.64\ )}{0.573}\ X_3 - \underset{(1.500)}{13.726}\ X_4,\ R^2 = 0.637$$

4. $$Y_9 = 2.536 - \underset{(1.981)}{0.083}\ Z_7 - \underset{(1.609)}{0.110}\ Z_8 + \underset{(2.082)}{0.717}\ X_3 - \underset{(1.136)}{10.303}\ X_1,\ R^2 = 0.619$$

5. $$Y_9 = 2.706 + \underset{(1.70)}{0.607}\ X_3 - \underset{(1.17)}{11.125}\ X_4,\ R^2 = 0.566$$

6. $$Z_1 = 789.95 + \underset{(8.98)}{63.41}\ Z_5 - \underset{(1.59)}{794.1}\ Z_7 - \underset{(1.07)}{872.8}\ Z_8,\ R^2 = 0.578$$

7 $$Z_1 = 492.5 - \underset{(2.95)}{1643.7}\ Z_9 + \underset{(\ 7.61)}{48.89}\ X_{14} + \underset{(1\ 64)}{840.1}\ X_{18},\ R^2 = 0.543$$

8. $$Z_1 = 520.3 - \underset{(1.84)}{1085.5}\ Z_7 - \underset{(0.59)}{548.9}\ Z_8 + \underset{(7.05)}{53.97}\ X_{14},\ R^2 = 0.461$$

9. $$Z_1 = 774 + \underset{(8.89)}{57.4}\ Z_5 - \underset{(2.22)}{1142\ 54}\ Z_9 + \underset{(1.47)}{695}\ X_{18},\ R^2 = 0.611$$

10. $$Z_2 = -82.8 + \underset{(6.97)}{82}\ Z_6 - \underset{(1.73)}{140.1}\ Z_7 - \underset{(0.76)}{106.2}\ Z_8,\ R^2 = 0.466$$

of this sub-section. Since x_4 is of the approximate order of 0.01, the relative positive contribution of the coefficient of x_3 is an important response coefficient arising from food expenditure variable. The approximate contribution of additional rupee (at 1970-71 prices) food expenditure to vitamin A intake at the household level is about 60 I. U. It may be noted that considering the average magnitude of deficiency of vitamin A intake, the additional experditure repuired to bridge the gap seems to be considerable; a rise of about 40 to 50 per cent in houeshold food expenditure is likely to fulfil the vitamin A requirement on an average. Also, separate analyais reveals that the cost of obtaining vitamin A through normal foods (governed by average food habits) is considerable, The possible remedy may lie in relatively less marketed foods like drumstick leaves or in artifcial doses of vitamin A (chemically produced).

As regards consumption of Iron (the relevant estimated relations given at the end of this sub-section), the relative roles of food expenditure versus total expenditure, education parameters, rural/urban location continue to play the same qualitative impact as in case of other nutrients discussed eariler. The contribution of addiicnal rupee (at 1970-71 prices) food expenditure to household increased the intake of Iron to around 34 mgms.

3. *Summary*

a) The relative roles of various economic and non-economic parameters affecting intake of the main nutrients, viz., calorie, protein, vitamin A and iron, are rather uniform among the nutrients; education parameters, for the reasons discussed in the previous Chapter, did not have any positive impact in influencing intake of any of the nutrients. Food expenditure, as expected, is the major determinant of intake of any of the nutrients.

C. Consumption of Vitamin A

1. $$Y_{12} = 2.532 - \underset{(2.501)}{0.152\ Z_7} - \underset{(1.779)}{0.177\ Z_8} + \underset{(0.352)}{0.175\ X_3} - \underset{(0.788)}{10.365\ X_4},\ R^2 = 0.246$$

2. $$Y_{12} = 2.421 - \underset{(1.659)}{0.082\ Z_7} - \underset{(1.582)}{0.128\ Z_8} - \underset{(1.133)}{0.059\ Z_9} + \underset{(1.546)}{0.632\ X_3} - \underset{(0.836)}{8.952\ X_4},\ R^2 = 0.510$$

D. Consumption of Iron

1. $$Y_5 = 517.306 + \underset{(8.29)}{33.526\ Z_5} - \underset{(1.674)}{489.628\ Z_7} - \underset{(1.597)}{763.181\ Z_8},\ R^2 = 0.534$$

2. $$Y_5 = 433.275 - \underset{(1.819)}{622.653\ Z_7} - \underset{(1.110)}{599.415\ Z_8} + \underset{(6.266)}{27.874\ Z_9},\ R^2 = 0.41$$

3. $$Y_6 = 10.106 + \underset{(5.896)}{41.275\ Z_6} - \underset{(2.014)}{97.069\ Z_7} - \underset{(1.317)}{109.483\ Z_8},\ R^2 = 0.411$$

4. $$Y_{11} = 2.162 - \underset{(1.938)}{0.093\ Z_7} - \underset{(1.872)}{0.148\ Z_8} + \underset{(1.871)}{0.744\ X_3} - \underset{(0.601)}{6.293\ X_4},\ R^2 = 0.50$$

5. $$Y_{11} = 2.351 + \underset{(1.493)}{0.62\ X_3} - \underset{(0.647)}{7.157\ X_4},\ R^2 = 0.421$$

6. $Y_{11} = 2.117 + 0.716\, X_3 - 6.308\, X_4 - 0.052\, Z_7 - 0.086 Z_8, \quad R^2 = 0.370$

$\phantom{Y_{11} = 2.117 +}\ (5.078) \qquad (0.958) \qquad (1.855) \qquad (2.775)$

7. $Y_{11} = 2.367 + 0.649\, X_3 - 10.384\, X_4 - 0.023\, Z_7 - 0.029\, Z_8 - 0.021\, Z_9, \quad R^2 = 0.473$

$\phantom{Y_{11} = 2.367 +}\ (5.019) \qquad (1.717) \qquad (0.887) \qquad (0.981) \qquad (8.043)$

8. $Y_{11} = 3.140 + 0.309\, X_{16} - 27.397\, X_{17} - 0.011\, Z_7 - 0.012\, Z_8 - 0.225\, Z_9, \quad R^2 = 0.351$

$\phantom{Y_{11} = 3.140 +}\ (2.366) \qquad (2.971) \qquad (0.375) \qquad (0.364) \qquad (8.057)$

9. $Y_{11} = 2.63 + 0.50\, X_3 - 13.71\, X_4 - 0.025\, Z_7 - 0.088\, Z_8, \quad R^2 = 0.362$

$\phantom{Y_{11} = 2.63 +}\ (3.835) \qquad (2.154) \qquad (1.01\ \ ) \qquad (3.144)$

10. $Y_{11} = 2.819 + 0.453\, X_3 - 17.742\, X_4 + 0.028\, Z_7 - 0.057\, Z_8 - 0.157\, Z_9 \quad R^2 = 0.428$

$\phantom{Y_{11} = 2.819 +}\ (3.632) \qquad (2.925) \qquad (0.95\ \ ) \qquad (2.109)$

11. $Y_{11} = 2.937 + 0.382\, X_{16} - 20.503\, X_{17} - 0.024\, Z_7 - 0.019\, Z_8 - 0.209\, Z_9, \quad R^2 = 0.365$

$\phantom{Y_{11} = 2.937 +}\ (3.447) \qquad (3.024) \qquad (0.922) \qquad (0.625) \qquad (8.285)$

b) In the estimated relations the coefficients corresponding to the food expenditure variables indicate that the marginal propensity to consume calories with additional expenditures is considerably high and the amount of calorie derived comes close enough to the calorie available by choosing low cost food items.

c) It appears that under the existing price structure and market mechanism governing the traditional food commodities, unless drastic improvements in income take place for the majority of population, it is not possible to eliminate the nutrition gap as far as vitamin A is concerned. The remedy appears to lie in popularisation of relatively less common foods like drumstick leaves, in addition to administering doses of vitamin A through chemical methods.

d) Combining the information summarised in Chapter 2 with the behavioural analysis governing the consumption of proteins, it appears that the protein gap can be automatically eliminated if calorie gap is eliminated. It, therefore, suffices to focus attention on nutrition deficiency in respect of calories; the equally important nutrient would be vitamin A.

e) Food habits, caste variables and education levels do not seem to have any significant impact on intake of any of the nutrients; for the same expenditure group, urban location, however, does adversely affect intake of any of the nutrients.

4

Demand Projections

1. Introduction

There are several empirical approaches to obtaining demand projections. Some of these are based on estimation of demand via assessment of influence of different economic and non-economic parameters; typically the methodology required for this purpose involves multi-variate regression analysis in addition to extrapolation (with appropriate method) of explanatory variables (influencing parameters). The other approach is to assess the demand, based on standard norms of nutrition requirements: given the age-sex size distribution of population, obtain the requirements of calories, protein, etc, for different years and convert these requirements into food equivalents, recognising the traditional consumption patterns.

Among the empirical studies dealing with demand models for nutrition are the aggregate all-India model estimated by Das Gupta. [6]These models explained much of the variation in the calorie-intake in terms of linear and non-linear relationships with extent, using simple regres sion models. Evidently the analysis is too aggregate to be of help for evolving any policy Interventions as the relative impact of different parameters is not assessed via these models.

---

6. R Das Gupta, Alternative Demand Models for Nutrition, Workshop on Nutrition Planning, Administrative Staff College of India, Hyderabad, 1981.

Kalirajan, et al,[7] in their empirical study with reference to Tamil Nadu using NSS data, estimated the expenditure elasticities and examined the stability of these elasticities over different time periods as seen from different rounds of NSS data. They found that for the 8,000 groups of consumption items, the elasticities are relatively stable. The exercise did not attempt projections of demand in Tamil Nadu.

2. **Forecasts of Net Availability**

Based on the time-series data of per capita net availability, time-trend method ($y^t = a+bt$) was utilised using data for 1966-67 to 1978–79 to forecast the net availablity, assuming that there may not be major changes in the factors (especially assuming continuance of imports of grams and pulses) and their behaviour affecting the components leading to assessment of per capita net availability. The forecasts are given in Table 4.1.

The nutrition implications of the declining trends in per capita consumption of fruits and milk and the increasing trends of other commodities are depicted in Table 4. 2. These are based on the trend projections of net availability of these items. Projections are obtained for per day per capita consumption of nutrients calorie, protein, vitamin A, iron and calcium. Data on per day per capita consumption of nutrients for the past 13 years (1965–66 to 1978-79) are available from Tamil Nadu food balance – sheets. This was projected based on trend extrapolation. The equations for the food groups other than rice, all cereals, grams and pulses, vegetables, fruits and milk are not satisfying any statistical properties. Therefore, only the aforesaid six groups were projected by this method. The remaining food

7. Kalirajan, K. et al. Temporal consumption patterns of Tamil Nadu. *Anvesak* June 1972, 2 (1).

groups which are not showing any significant statistical properties are clubbed and projected on the basis of only the compound growth rates of 1.95, 0.4, 1.5, 2.4, 0.25 in case of calorie, protein, vitamin A, iron and calcium, respectively.

The per capita per day availability of vitamin A is likely to decline further by more than 10 per cent during the next eight years.

3. Regression Models

In order to assess the implications of the varying prices and incomes during the period up to 1986-87, the functional relationships between the consumption and these parameters are estimated and also used for the projections in respect of food items, as a consequence of attainment of different levels by income and price variables. The projections in respect of these explanatory variables are based on trend method using time series data.

The main purpose in obtaining the projections whether in terms of nutrients or in terms of food equivalents, is to assess not only the gap between the normative demand and the likely demand (that is, normative consumption and effective consumption), but also assess the relative gaps in different food items in comparison with production of these items in Tamil Nadu.

The integration of demand and supply of nutrients via demand and supply of food commodities can be attempted through a number of policy intervention strategies covering the production and consumption systems; the type and magnitude of these interventions will be assessed on the basis of the estimated gaps[8]. These aspects are analysed in a separate report[9].

8. The Integrated Planning Models in conjunction with certain simple analysis is expected to yield the necessary approaches.

9. Integrated Nutrition Planning—A Synthesis.

Table 4.1: Forecasts of Per capita Consumption of Food in Tamil Nadu

$y = a + bt$ $\quad$ y = consumption $\quad$ t = time $\quad$ gr/day

Commodity	Equation Const. term	Equation Reg. co-eff	Correlation co-efficient	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89
Rice	244.6	5.07	0.44	325.7	330.8	335.9	340.9	346.0	351.1	356.1	361.2
	(9.76)	(1.61)									
All cereals	346.7	5.16	0.40	429.3	434.4	439.6	444.7	449.9	455.1	460.2	465.4
	(12.4)	(1.46)									
Grams and pulses	22.8	0.24	0.32	26.6	26.9	27.1	27.4	27.6	27.8	28.1	28.3
	(13.1)	(1.16)									
Vegetables	40.9	0.37	0.47	46.8	47.2	47.6	47.9	48.3	48.7	49.0	49.4
	(24.9)	(1.73)									
Fruits	121.1	-1.96	-0.69	89.7	87.8	85.8	83.8	81.9	79.9	78.0	76.0
	(24.3)	(3.12)									
Milk	91.3	-0.64	-0.98	81.0	80.0	79.8	79.1	78.5	77.8	77.2	76.6
	(31.1)	(17.68)									
Total	758.2	4.43	0.33	763.5	763.8	764.1	764.5	764.8	765.1	765.5	765.8
	(24.7)	(1.15)									

(Figures in the brackets are t - ratios)

Data relate to Food Balance Sheets, Tamil Nadu (1966-67 to 1978-79)

Table 4.2 : Projections for per capita Nutrient Availability

(a) Calorie (K. cal/day)

Commodity	1979-80	1983-84	1988-89
Rice	1091	1162	1250
All Cereals	1433	1508	1596
Grams and pulses	89	92	96
Vegetables	24	24	25
Fruits	57	52	46
Milk	96	93	89
Other commodities	557	601	662
Total	2256	2370	2514

(b) Protein (gm/day)

Rice	20	21	23
All cereals	30	31	33
Grams and pulses	6	6	6
Vegetables	1	1	1
Fruits	0.9	0.8	0.7
Milk	3	3	3
Other commodities	6	6	6
Total	47	48	50

(Contd. on Page 63)

(Contd. from Page 62)

(c) Vitamin A (I.U/day)

Commodity	1979-80	1983-84	1988-89
All cereals	109	109	110
Grams and pulses	31	32	34
Vegetables	255	264	274
Fruits	813	744	659
Milk	132	127	122
Other commodities	161	171	185
Total	1501	1447	1384

(d) Iron (mg/day)

Rice	13	13	14
All cereals	19	19	20
Grams and pulses	2	2	2
Vegetables	1	1	2
Fruits	8	7	6
Milk	0.2	0.2	0.2
Other commodities	4	5	5
Total	34	34	35

(e) Calcium (mg/day)

Rice	375	399	429
All cereals	470	495	515
Grams and pulses	31	32	34
Vegetables	32	33	35
Fruits	23	21	19
Milk	173	167	161
Other commodities	82	83	86
Total	811	831	850

Single Education Models

(a) *Engel Functions* :

The selection of Engel forms which relate income/ expenditure with consumption, depends to some extent on the desired properties of the underlying economic decision-making criteria (utility functions) of the individual or household. The considerations governing the choice of these forms are of there types:

1. Connecting with direct or indirect utility functions;
2. The validity of the function for all positive values of individual/family budget levels or at least in a wide range; also, the implied elasticities of demand should be plausible (that is, a priori considerations on magnitude of elasticity also govern the selection);
3. Computational considerations—in terms of estimation of Engel functions should be simple and convenient, amenable for assessing the goodness of it and other statistical properties. A set of Engel functions for all income levels may not, however, allow extrapolation of the Engel functions significantly beyond the observed range of individual/family budget levels. The general statistical consideration is that the errors representing the individual variations in tastes as differences between observed and habitual expenditure patterns, may be assumed to be proportionate to the total budget outlay of the individual/household of all goods and services.

An estimation of several forms of Engel curves was attempted; in order to capture the effect of income/expenditure in smaller intervals, the Engel curves were estimated for different expenditure groups. The relations, however, turned out to be statistically rather insignificant. Although there is a prossibility that by extending the range of values of income/ expenditure, the relations could possess improved statistical

properties, this exercise was not attempted. Instead, the multi-variate regression analysis which, alongwith other variables, includes income as an explanatory variable may be more useful. These relations were reported in Chapter 3 and some are presented here in this chapter.

(*i*) *Expenditure groups: Rs. 0-50 (Sample size: 32)*

a) $$109\ Y = -7.61 + \underset{(2.952)}{4.491} \log X, \quad (R = 0.47)$$

(*ii*) *Expenditure group: Rs. 51 - 100 (Sample size: 94)*

a) $$Y = 144.1 + \underset{(4.459)}{3.71}\ X, \quad (R = 0.421)$$

b) $$Y = -1137.09 + \underset{(5.085)}{850.86} \log X, \quad (R = 0.468)$$

(*iii*) *Expenditure group: Rs. 101 - 150 (Sample size. 93)*

a) $$Y = 211.276 + \underset{(4.25)}{2.691}\ X, \quad (R = 0.4)$$

(*iv*) *Expenditure group: Rs. 151 - 200 (Sample size: 73)*

a) $$\log Y = 21.287 - \underset{(3.197)}{372.589} \frac{1}{X} - \underset{(2.203)}{7.644} \log. X, \quad (R = 0.4)$$

(*v*) *Expenditure group: Rs. 201 - 300 (Sample size: 60)*

a) $$Y = 3702.7 - \underset{(1.723)}{84454.3} \frac{1}{X}\ \underset{(1.115)}{1096.48} \log X, \quad (R = 0.335)$$

(*vi*) *Expenditure group: Rs. 301 - 400 (Sample size: 51)*

a) $$Y = 1036.97 - \underset{(1.805)}{47756.2} \frac{1}{X}, \quad (R = 0.249)$$

(*vii*) *Expenditure group: Rs. 401 - 600 (Sample size: 33)*

a) $$Y = -12896.36 + \underset{(3.142)}{385530.0} \frac{1}{X} \quad \underset{(3.523)}{5027.6} \log X,$$

$(R = 0546)$

(*viii*) *Expenditure group: Rs. 601 - 800 (Sample size 9)*

a) $Y = -160.8 + 3.625 X$, $(R = 0.606)$
$$(2.017)$$

(*ix*) *Expenditure group: Rs. 801 and above (Sample size: 13)*

a) $Y = 20037.7 - 876829.0 \frac{1}{X} - 6591.68 \log X$, $(R = 0.364)$
$$\quad\quad(1.218) \qquad\qquad (1.236)$$

b) Multiple Regression Equations:

The demand for cereals rice, wheat, jowar, bajra, ragi, minor cereals, and all cereals is estimated using the regression model.

$$C_t = A + BP_t + CY_t$$

where C_t = Consumption in time t

P_t = Wholesale prices in time t

Y_t = State domestic product at constant prices in time t.

The regression equation obtained in the case of all cereals is

$$(1) \quad C_t = 4030.59 - \underset{(2.44)}{13.42}\, P_t + \underset{(4.9)}{30.03}\, Y_t, \quad \bar{R}^2 = 0.698$$

The corresponding equation for rice is :

$$(2) \quad C_t = 3727.54 - \underset{(2.56)}{14.77}\, P_t + \underset{(4.79)}{30.79}\, Y_t, \quad \bar{R}^2 = 0.678$$

The regression results regarding all the other cereals are rejected for possessing low $\bar{R}^2$ and insignificant co-efficients.

The projections of demand for cereals, based on the regression relation (1) after incorporating projected values of income and prices (based on trend method) in the above relation, are given in Table 4.3.

In order to facilitate the analysis of demand for different food items under varying conditions governing prices and incomes, a number of linear and non-linear relations have been estimated. These are also presented at the end of this section. These equations can also be made use of for projecting the demand. The declining trend of effective demand for milk can be easily seen from the equation regarding C_7. It may be noted that almost all the regression relations presented later have the desired co-efficients in terms of direction of impact (positive impact due to income and negative due to prices). Also, most of the co-efficients have significant t-ratios. Therefore, these relations can be considered for forecasting purposes. A few additional relations for ragi, milk as well as rice and cereals in different functional forms are estimated and given below. These can also be used for forecasting purposes. Some of these forecasts are given in Tables 4.4 to 4.11.

Notations used for Demand for Food in Tamil Nadu

C_1 = Demand for rice

C_2 = $\log_{10}$ of demand for rice

C_3 = Demand for ragi

C_4 = $\log_{10}$ of demand for ragi

C_5 = Demand for all cereals

C_6 = $\log_{10}$ of demand for all cereals

C_7 = $\log_{10}$ of demand for milk

P_t = Price of commodity at 1970-71 prices

I_t = Index of State income at 1970-71 prices

IP_t = Index of whole-sale prices

RP_t = Relative price of commodity (with respect to price of rice)

t = Time

Demand for Food in Tamil Nadu

1. $$C_1 = \underset{(9.30)}{10753.5} - \underset{(4.34)}{18.56}\, p_t - \underset{(6.15)}{469342} \times \frac{1}{I_t}, \quad R^2 = 0.81$$

2. $$C_1 = \underset{(9.40)}{10793.9} - \underset{(4.41)}{18.80}\, Ip_t - \underset{(6.23)}{474265.0} \times \frac{1}{I_t}, \quad R^2 = 0.81$$

3. $$C_2 = \underset{(10.60)}{2.65} - \underset{(2.68)}{0.62}\, p_t + \underset{(3.77)}{1.08}\, I_t, \quad R^2 = 0.66$$

4. $$C_3 = \underset{(3.52)}{324.4} - \underset{(0.97)}{58.90}\, Rp_t + \underset{(2.84)}{0.81}\, I_t, \quad R^2 = 0.56$$

5. $$C_4 = \underset{(16.1)}{2.22} - \underset{(1.52)}{0.35}\, p_t + \underset{(2.56)}{0.17}\, I_t, \quad R^2 = 0.52$$

6. $$C_5 = \underset{(0.79)}{6290.4} - \underset{(0.31)}{2362.7}\, RP_t + \underset{(3.20)}{18.50}\, I_t, \quad R^2 = 0.56$$

7. $$C_5 = \underset{(10.3)}{13621.8} - \underset{(4.01)}{19.7}\, Ip_t - \underset{(6.51)}{560229} \times \frac{1}{I_t}, \quad R^2 = 0.85$$

8. $$C_6 = \underset{(12.45)}{3.03} - \underset{(0.37)}{0.48}\, p_t + \underset{(3.14)}{0.36}\, I_t, \quad R^2 = 0.55$$

9. $$C_7 = \underset{(646.5)}{1.97} - \underset{(9.66)}{0.04}\, t, \quad R^2 = 0.90$$

Note : Figures in brackets are t–ratios

TABLE 4.3 : Demand for Cereals – Tamil Nadu

Year	State Domestic Product (Y_t)* (Rs. Crores)	Wholesale prices cereals (P_t)* (Rs./Quintal)	Demand for cereals ('000 tonnes)
1979-80	5151	208.19	7670.91
1980-81	5437	219.29	7879.30
1981-82	5722	230.39	8086.50
1982-83	6007	241.49	8293.39
1983-84	6293	252.59	8501.78
1984-85	6578	263.69	8708.66
1985-86	6863	274.79	8915.87
1986-87	7148	285.89	9123.07
1987-88	7434	296.99	9331.16
1988-89	7719	308.09	9535.95
1989-90	8004	319.19	9745.55

* Projections of these variables based on trend method.

Prices : $P = 52.79 + \underset{(4.77)}{11.1}\, t, \quad R^2 = 0.62$

Income : $Y = 1157.28 + \underset{(15.52)}{285.29}\, t, \quad R^2 = 0.96$

Data Sources : (1) RBI Bulletin April 1978, June 1979.

(2) Department of Statistics, Tamii Nadu.

(3) Tamil Nadu Food Balance Sheets, Tamil Nadu, Nutrition Project Office, Madras.

Table 4.4 : Demand for Cereals at 5% Increase in Relative Prices and 5% Increase in SDP.

('000 tonnes)

Year	Demand for Cereals
1981-82	8037.5
1982-83	8279.4
1983-84	8532.4
1984-85	8796.6
1985-86	9050.0
1986-87	9338.2

Table 4.5 : Demand for Cereals at 5% Decrease in Relative Prices and 5% Increase in SDP.

('000 tonnes)

Year	Demand for Cereals
1981-82	8273.8
1982-83	8515.7
1983-84	8761.3
1984-85	9032.8
1985-86	3286.3
1986-87	9574.5

Table 4.6 : Forecasts of Demand for Cereals at 5% Increase in Relative Prices and 3% Increase in SDP

(000' tonnes)

Year	Demand for Cereals
1981-82	7713.7
1982-83	7857.6
1983-84	8007.1
1984-85	8158.3
1985-86	8291.5
1986-87	8452.1

Table 4.7 : Forecasts of Demand for Cereals at 5% Decrease in Relative Prices and 3% Increase in SDP

(000' tonnes)

Year	Demand for Cereals
1981-82	7950.0
1982-83	8093.9
1983-84	8243.3
1984-85	8394.6
1985-86	8527.8
1986-87	8688.3

Table 4.8 : Forecasts of Demand for Ragi at 5% Increase in Relative Prices and 5% Increase in SDP

(000' tonnes)

Year	Demand for Ragi
1981-82	458.0
1982-83	470.5
1983-84	482.3
1984-85	495.2
1985-86	508.1
1986-87	521.4

Table 4.9 : Forecasts of Demand for Ragi at 5% Decrease in Relative Prices and 5% Increase in SDP

(000' tonnes)

Year	Demand for Ragi
1981-82	463.9
1982-83	475.2
1983-84	487.0
1984-85	499.9
1985-86	512.8
1986-87	526.1

Table 4.10 : Forecasts of Demand for Ragi at 5% increase in Relative Prices and 3% Increase in SDP

(000' tonnes)

Year	Demand for Ragi
1981-82	433.8
1982-83	452·0
1983-84	459.3
1984-85	466.5
1985-86	474.8
1986-87	482.6

Table 4.11 : Forecasts of Demand for Ragi at 5% Decrease in Relative Prices and 3% Increase in SDP

(000' tonnes)

Year	Demand for Ragi
1981-82	449.7
1982-83	456.7
1983-84	464.0
1984-85	471.9
1985-86	479.6
1986-87	487.3

Survey of Elasticities

The estimates of expenditure elasticities based on TNNP Data Bank and NSS 20th and 28th rounds of data for different items are given below:

Item	TNNP Data (1971-72)	NSS 20th round (1965-66)		NSS 28th rouud (1973-74)	
		Rural	Urban	Rural	Urban
Cereals	0.91	0.60	0.28	0.61	0.30
Pulses	0.85	1.28	0.77	1.21	0.90
Milk & milk products	1.68	1.95	1.36	2.05	1.49
Food	—	0.84	0.71	0.87	0.73
Non-food	1.07	—	—	—	—

Source : Tamil Nadu Nutrition Project Data Bank

Based on the past data for the period 1966-67 to 1977-78, the income elasticity for demand for cereals is estimated to be around 0.62, and for rice around 0.70.

The above estimates indicate near closeness of different estimates of elasticities. It may be observed that there is no significant difference in elasticities over different rounds of NSS data during 1968–66 to 1973–74. The rural-urban differences, however, are noticeable. The highest income elasticity applies to milk and milk products. Given the fact that there is considerable vitamin A deficiency in Tamil Nadu, this is a welcome feature provided the income levels increase significantly. It is useful to investigate further the break up of income elasticities for different sections of population. Table 4.12 gives the estimates based on a study conducted by the World Bank.

Table 4.12 : Calorie Response Elasticities to Income [1]

Country	Poorest 10%	Calorie Poverty line[2]	Richest 10%
Bangladesh	0.69	0.42	0.34
India	0.85	0.59	0.33
Indonesia	0.77	0.49	0.30
Morocco	1.04	0.59	0.35
Pakistan	0.32	0.29	0.24
Sri Lanka	0.22	0.22	0.17

1. Derived from semi-log function fitted to household consumption data of calorie intake per capita versus total expenditure per capita.
2. The calorie poverty line is the level of income at which the consumer would purchase the calorie requirement.

: Nutrition and Food Needs in Developing Countries. Odin Knudsen. Pasquale L. Scandizzo. Agriculture and Rural Development Department, World Bank Staff Working Paper No. 328, May 1979.

If the calorie responses to income increases are lower than normal growth rates of income, it would bear minor impact towards eliminating malnutrition and the need for direct intervention schemes like public distribution system, supplementary feeding, other subsidies, becomes relevant as the market distribution system alone cannot solve the problem. This is particularly valid considering the fact that the income elasticity of demand for food is only around 0.5 on an average. This would mean that even with an increase of 10 per cent in income, the growth rate in consumption of calories is going to be roughly only 5 per cent.

4. Normative Demand :

It is proposed to arrive at projections for the period up to 1986-87 in respect of nutrients based on standard ICMR (1968) norms, considering the age-size-distribution of population for the relevant period. For operational purposes, it is useful to obtain the food gaps based on the projections using

time series data in respect of the net availability of different food items and food equivalents of normative demand projections of calories. In order to convert calories into equivalents, the existing pattern of food consumption; the calorie distribution across commodities will be made use of.

Food and Nutrition Gaps (1981-82 to 1986-87)

Determination of food gap for the State as a whole and for the districts is an important exercise we attempted in this report. As we do not have data to determine the food consumption behaviour on a district-wise basis, we have to depend upon the food behaviour of the State as a whole.

For calculating the food gaps for the districts, we have to know two factors : i) actual consumption of food items, and ii) normative requirements, food - equivalents of normative nutrition needs based on the ICMR norms. In calculating the consumption of food items we projected the per capita consumption of major commodities based on the net availability figures of the past few years, by trend method. Assuming the consumption pattern is the same across the districts, multiplying forecasts of per capita consumption by the population (age-group-wise projections available from the Tamil Nadu Planning Commission), we arrive at the estimates of food consumption by districts and by State as a whole for the years 1979-80 to 1986-87.

In estimating the calorie requirements for the districts, we used ICMR calorie norms per person and multiplied by the estimated population of the districts, after superimposing the age-distribution available for the State to be uniformly valid across districts) and converting it into adult equivalent units. The total requirements of calories for districts for each year is converted into food equivalents based on the State-level average food habits indicating the distribution of calories across food commodities.

It is found that the food gap is decreasing for all commodities except for fruits wherein the gap is increasing over the relevant period. Rice, and grams and pulses would become surplus in the year 1983-84 and 1982-83, respectively, whereas the overall deficit of cereals remains till 1985-86 with a decreasing trend. The gap of fish requirement remains almost the same over the period. The projections are given in Table 4.13.

Table 4.13 : Food Gaps between Requirements and Consumption for Tamil Nadu

(000' tonnes)

Year / Commodity	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	157.2 (2.5)	69.2 (1.1)	-22.6 (-0.4)	-110.4 (-1.7)	-222.3 (-3.3)	-316.0 (-4.6)
All cereals	504.7 (5.9)	425.2 (4.9)	339.7 (3.9)	260.2 (2.9)	150.1 (1.6)	-37.5 (-0.4)
Grams & pulses	0.7 (0.1)	-4.0 (-0.9)	-13.9 (-2.7)	-13.4 (-2.5)	-18.2 (-3.4)	-21.5 (-3.9)
Vegetables	149.6 (14.7)	145.7 (14.1)	128.0 (12.1)	140.1 (13.0)	133.1 (12.2)	129.5 (11.6)
Fruits	978.1 (37.0)	1034.6 (38.4)	1094.3 (39.9)	1159.0 (41.4)	1212.7 (42.6)	1280.2 (44.3)
Milk	-125.7 (-9.1)	-115.5 (-8.2)	-105.1 (-7.4)	-91.1 (-6.2)	-82.4 (-5.6)	-66.7 (-4.4)
Starchy foods	294.4 (32.5)	263.0 (28.5)	249.4 (26.4)	216.4 (22.5)	198.9 (20.4)	163.9 (16.5)
Sugar	-132.4 (-29.0)	-336.2 (-30.6)	-360.8 (-32.2)	-385.7 (-33.7)	-433.2 (-37.3)	-458.7 (-38.8)
Fish	61.9 (14.3)	63.5 (14.4)	65.0 (14.5)	67.0 (14.6)	87.5 (18.8)	90.0 (18.9)

Figures in brackets are percentage of gap to total requirement

An important caution should be exercised in this table and its interpretation. Since the trend method is used to project per capita consumption, based on the net availability figures, the major assumption involved in the calculation of the gaps is that the net food imports will continue to operate as in the past (alongwith relevant rise as depicted by trends in imports) for the next few years. Therefore, the scenario depicting some surpluses is not surprising. What is of greater interest is to find out the food nutrition gaps between normative demand and production in Tamil Nadu and also between behavioural demand and production. These exercises are carried in a seperate report entitled Integrated Nutrition Planing—A Synthesis.

In order to obtaic estimates of specific nutrient requirements for different age-groups in each district, a detailed exercise was carried out and the results are given in Annexures 1 to 39.

These annexures deal with the following projections :

1 Age-group-wise requirements of calories for State-wise and district-wise (Annexures 1 to 15)

2 Age-group-wise requirements of proteins for Tamil Nadu for State (Annexure 16)

3 Age-group-wise requirements of vitamin A for State (Annexure 17)

Age-group-wise requirements of iron for State (Annexure 18)

5 Age-group-wise requirements of calcium for State (Annexure 19)

6 Age-group-wise vitamin-A requriements for children in Tamil Nadu (District-wise) (Annexures 20 to 22)

7 Age-group-wise iron requirements for children in Tamil Nadu—District-wise (Annexures 23 to 25)

8 Food gaps between requirements and consumption and district-wise (Annexures 26 to 39)

Normative Demand

Table 4.14 indicates the calorie gap for the years 1981-82 to 1986-87 projected on the basis of projections of normative demand for nutrients and projections of the net availability of nutrients. The per capita calorie gap per day works out to around 60 calories for 1981-82, assuming continuance of imports of food items as in the past. Food-item-specific gaps (given the normal patterns of consumption) are given in the last column of Table 4.15.

Various projections of normative demand requirements given in this report are based on the population projections provided by the Tamil Nadu State Planning Commission. Subsequently we could obtain the aggregrate figures of population in Tamil Nadu for 1981 based on the 1981 census data. Table 4.14 indicates the comparative figures for 1981 based on these two sources of information. Apparently, due to vigorous efforts in family planning, the birth control is more effective and thus there is reduction in the projected figures by about less than 4 per cent. To this extent the estimated food and nutrition requirements and gaps (presented in various tables in this Report) need to be reduced (ignoring for the present the change in age-pyramid structures).

Table 4.14 : Comparison of State Planning Commission's Population projections with Census 1981 for Tamil Nadu

	Census 1981	Tamil Nadu Planning Commission 1981
Males	24,420,228	25,653,300
Females	23,877,828	25,107,800
Total	48,297,456	50,761,100
Sex ratio (No. of females/1000 males)	978	979

Table 4.15 : Calorie Gaps between Requirements and Consumption in Tamil Nadu

(million K. Cals)

Commodity	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	Perception/ day gap for 1981-82 (K Cals)
Rice	543912	239432	-78196	-381984	-769158	-1093360	31
All cereals	1524194	1284104	1025894	786408	453302	-113250	86
Grams & pulses	2373	-13560	-47121	-45426	-61697	-72885	-
Vegetables	45030	43856	38528	42170	40063	38980	3
Fruits	596641	631106	667523	706990	739747	780922	34
Milk	-147069	-135135	-122967	-106587	-96408	-78039	-8
Starchy foods	259072	231440	219472	190432	175032	144232	15
Sugar	-1218360	-1311180	-1407120	-1504230	-1689480	-1788930	-69
Fish	37759	38735	39650	40870	53375	54900	2
						Total	63

After the draft of this report was prepared where nutrition requirements were assessed based on the ICMR (1968) norms, we obtained the recently revised ICMR (1981) norms. Based on the revised norms we computed at the aggregate level for the population in Tamil Nadu (based on Tamil Nadu Planning Commission projections for 1981) the requirement of calories and compared these with the estimated requirements for the same age-sex-size distribution of population using the previous norms. The net effect is that the requirement of calories goes up by about 3.2 per cent as indicated below :

COMPARISON OF ICMR NORMS:-1971 & 1981

Required calories for Tamil Nadu according to 1971 norms	= 1079156840 K. Cal.
Required calories for Tamil Nadu according to 1981 norms	= 1114133680 K. Cal.
Increase	= 34976840 K. Cal.
Percentage increase	= 3.2

Combining the two factors (1) the net effect of adjustment needed in population estimates by 1981 consus, and (2) the revised ICMR norms and their impact on calorie requirements, we find that the estimated normative requirements for calories at the aggregate level (and their food equivalents) need not undergo any significant change as the effects of the above factors work in opposite directions with approximately the same magnitude (in the range 3 to 4 per cent).

5

Conclusions

The main findings of this report are summarised below:

a) (i) As regards the trends in the net availability of different food and nutrition elements, it appears that vitamin A deficiency in Tamil Nadu which is the second most important nutrition deficiency (the first being calorie); it is going to be on the increase, especially since there appears to be a declining trend in the net availability of milk and fruits. Urgent steps are needed to rectify this situation.

ii) It is generally observed that if the calorie requirements are met, protein and iron requirements are also automatically met. This is not true as far as vitamin A is concerned. Special attention is needed in this regard either in terms of artificial doses of vitamin A or augmenting the supply of natural foods, mainly leafy vegetables, fruits, and milk.

iii) The gains in marginal increase in per capita per day availability of food seems to be mainly due to a declining trend of the population growth rate since 1972-73, rather than due to any significant increase in the production of food commodities.

(iv) It is estimated that, on an average, about 86 K calories and 2 gms. of protein per day per capita are wasted. Although it is practically imposible to eliminate completely the wastage component it is possible to reduce it. It is very useful to investigate the social cost-benefit implications of varying investment patterns for reducing the wastage at different levels for observations, it is possible to identify the relative priorities intervention in food processing systems in

reducing the wastages. It emerges that improved food processing and preserving methods, especially in the case of perishables like fruits are likely to be socially profitable and might justify investment in this direction for reducing the wastage.

(v) The officially classified categorisation of castes in Tamil Nadu into backward and other groups did not help us to identify these parameters as any relevant in determining the health status of children. Similarly, food habits in terms of vegetarianism and non-vegetarianism also did not provide any significant explanation to the illness phenomenon.

(b) (i) The urban location of a household does adversely affect the nutrition intake compared to a household located in rural areas, for the same expenditure levels ; the adverse impact of literacy possibly leading to occupation in an urban area also affects in the same way.

(ii) Food habits in terms of vegetarianism and non–vegetarianism do not seem to have any significant impact on variations in nutrition intake.

(iii) The marginal propensity to consume calories is of the order of 2,300 K calories per additional rupee (at 1970–71 prices) expenditure ; the corresponding increase in the case of proteins is about 50 gms, in the case of vitamin A it is about 60 I U., whereas in the case of iron it is about 34 mgms It appears that protein gap can be automatically eliminated if calorie gap is eliminated, and therefore, it suffices to focus attention mainly on vitamin A. It also appears that under the existing price structure and market mechanism governing the traditional food commodities, unless drastic improvements in income take place for the majority of population, it is not possible to eliminate the nutrition gap as far as vitamin A is concerned. The remedy appears to lie in popularisation of relatively less common foods like drumstick leaves, in addition to administering doses of vitamin A.

Annexure 1

Age group-wise Requirements of Calorie for Tamil Nadu

(million K. Cals. per day)

Age Group wise Year	0-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	Total
1979	4164.4	7531.8	8374.9	11401.4	10637.1	11805.3	9955.6	17374.4	12614.0	7943.2	5634.5	110178.4
1980	4141.2	7568.5	8611.7	11805.7	10808.9	11950.0	10083.4	17658.9	12917.5	8168.5	5880.0	109599.3
1981	4096.9	7579.6	8850.6	12252.7	10990.1	12096.2	10220.7	17949.4	13226.8	8395.8	6131.8	111790.6
1982	4099.2	7610.1	8949.8	12625.4	11287.0	12274.6	10356.9	18240.5	13529.3	8629.1	6391.3	113993.2
1983	4102.8	7629.6	9003.9	13001.9	11628.8	12464.5	10493.9	18529.9	13808.6	8865.9	6657.2	116187.0
1984	4107.8	7638.3	9012.8	13382.2	12015.1	12666.1	10632.1	18935.6	14139.9	9105.9	6930.4	118616.2
1985	4114.4	7636.6	8977.0	13766.2	12446.6	12878.7	10770.9	19104.9	14448.9	9350.0	7210.1	120443.0
1986	4122.5	7624.2	8895.8	14153.9	12922.9	13103.1	10910.8	19389.3	14575.5	9597.1	7496.8	122791.9

Source : Nutrition and food Needs of Tamil Nadu. Ministry of Agriculture, Govt. of India.

Annexure 2

Age group-wise Calorie Requirements for Tamil Nadu District : Madras

(million K. Cals. per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	273.7	277.5	274.5	278.7	283.1	287.5	288.0	292.7
3-5	497.1	507.1	507.8	517.5	520.4	534.7	534.6	541.3
6-9	552.7	576.9	593.0	608.6	621.3	630.9	628.4	631.6
10-14	752.5	791.0	820.9	858.5	897.1	936.7	963.6	1004.9
15-19	702-0	724.2	730.3	767.5	802.4	841.1	871.3	917.5
20-24	779.1	800.6	810.4	834.7	860.1	886.6	901.5	930.3
25-29	657.1	675.9	684.8	704.3	724.1	744.2	753.7	774.7
30-39	1146.6	1183.1	1202.6	1240.4	1278.6	1329.0	1337.0	1376.6
40-49	832.5	865.2	886.4	920.0	952.8	989.8	1011.0	1034.8
50-59	524.2	547.3	562.5	586.8	611.7	637.5	654.5	681.4
60+	371.9	393.9	410.8	424.6	459.3	485.1	504.7	532.3
Total	7089.4	7342.7	7490.0	7751.6	8016.9	8303.1	8538.4	8718.1

Annexure 3

Age group-wise Calorie Requirement for Tamil Nadu District : Chingelput

(million K. Cals. per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	299.8	293.2	299.1	299.2	299.5	299.9	300.4	305,1
3-5	542.3	544.9	553.3	555.5	556.9	557.6	557.5	564.2
6 9	603.0	620.0	646.1	653.3	657.3	657.9	655.3	658.3
10-14	820.9	850.0	894.4	921.6	949.1	976 9	1004.9	1047.3
15-19	765.9	778.2	802 3	823.9	848 9	877.1	908.6	956 3
20-24	850.0	860.4	833.0	893.0	909.9	924,6	940.1	969 2
25-29	716.3	726.4	746.1	756.0	766 0	776.1	786.3	807.4
30-39	1258.9	1271.4	1310.3	1331.6	1352.7	1385.9	1394.6	1434.8
40-49	908.2	930.1	965 6	987.6	1007.9	1032.2	1054.7	1078.6
50-59	571.9	583.1	612.9	629.9	647.2	664.7	682.6	710 2
60+	405.6	423.4	447.6	466.6	485.9	505.9	526 3	554.8
Total	7745.3	7891.1	8160.7	8321.2	8481.3	8658.8	8811.3	9086.2

Annexure 4

Age group-wise Calorie Requirements for Tamil Nadu, District : North Arcot

(million K. Cals. per day)

Age Group	1979	1980	1081	1982	1983	1984	1985	1986
0- 2	366.5	364.4	360.5	356.6	356.9	357.4	358.0	354.5
3- 5	662.8	666.0	667.0	662.1	663.8	664.5	664.4	655.7
6- 9	737.0	757.8	778.8	778.6	783.3	784.1	781.0	765.0
10-14	1003.3	1038.9	1078.2	1098.4	1131.1	1164.2	1167.6	1217.2
15-19	936.1	951.2	967.1	981.9	1011.6	1045.3	1082.8	1111.4
20-24	1038.8	1051.6	1064.5	1067.9	1084.4	1101.9	1120.4	1126.8
25-29	876.1	887.7	899·4	901.1	912.9	925.0	937.1	938.3
30-39	1528.8	1554.0	1579.5	1586.9	1612.1	1651.7	1662.1	1667.4
40-49	1110.0	1136.7	1163.9	1177.0	1201.3	1230.2	1256.9	1253.5
50-59	699.0	718.8	733.8	750.7	771.3	792.2	813.5	825.3
60 +	495.8	517.4	539.6	556.0	579.2	602.9	627.3	644.7
Total	9454.2	9644.5	9837.3	9917.2	10107.9	10319.4	10501.1	10059.8

Annexure 5

Age group-wise Calorie Requirements for Tamil Nadu. District : South Arcot.

(million K. Cals. per day)

Age Group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	358.1	352.0	348.2	348.4	348.7	345.0	345.6	346.3
3-5	647.7	643.3	644.3	646.9	648.5	641.6	641.5	640.4
6-9	720.2	732.0	752.3	760.7	765.3	757.0	754.1	747.2
10-14	980.5	1003.5	1041.5	1073.2	1105.2	1124.1	1156.3	1188.9
15-19	914.8	918.8	934.2	959.4	988.4	1009.3	1045.5	1085.5
20-24	1015.3	1015.8	1028.2	1043.3	1059.5	1063.9	1081.8	1100.7
25-29	856.2	857.5	863.8	880.3	891.9	893.1	904.7	916.5
30-39	1494.1	1501.0	1525.7	1550.4	1575.0	1594.8	1604.8	16[illegible]8.7
40-49	1084.8	1098.0	1124.3	1150.0	1173.7	1187.7	1213.6	1224.3
50-59	511.1	694.3	713.6	733.5	753.6	764.8	785.4	806.2
60+	484.6	499.8	521.2	543.3	565.9	582.1	605.6	629.7
Total	9067.4	9316.0	9502.3	9689.4	9875.7	9963.4	10,138.9	10314.4

Annexure 6

Age Group-wise Requirements for Tamil Nadu. District: Dharmapuri

(Million K. Cals. per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	179.1	178.1	180.3	180.4	180.5	180.7	185.1	185.5
3 5	323.9	325.4	333.5	334.8	335.7	336.1	343.6	343.1
6-9	360.1	370.3	389.4	393.8	396.2	396,6	403.9	400.3
10-14	490.2	507.6	539.1	555.5	572.1	588.8	619.5	636.9
15-12	457.4	464.8	483.6	496.6	511.7	528.6	560.1	581.5
20-24	507.6	509.5	532.2	540.1	548.4	557.3	579.6	689.6
25-29	428.1	433.8	449.7	455.7	461.7	467.8	484.7	490.9
30-39	747.1	759.3	789.8	802.6	815.4	835.4	859.7	872.2
40-49	524.4	551.1	581.9	595.3	607.6	622.1	650.2	655.9
50-59	341.6	351.2	368.9	379.7	390.1	400.6	420.7	431.9
60 +	242.3	252.8	269.8	281.2	292.9	304.9	324.5	337.3
Total	4601.8	4703.9	4918.2	5015.7	5112.2	5218.9	5431.6	5625.1

Annexure 7

Age group-wise Calorie Requirements for Tamil Nadu. District : Salem

(million K. Cals. per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	508.2	506.4	507.3	507-4	507.7	508.1	509.0	513.3
3-5	557.3	560.1	568.5	570.7	572.2	572.9	572.7	579.4
6-9	619.7	637.3	663.8	671.2	675.3	675.9	673.3	676.1
10-14	843.7	873.6	918.9	946.9	975.1	1003.7	1032.5	1075.7
15-19	787.1	799.8	824.2	846.5	872.2	901.1	933.5	982.1
20-24	873.6	884.3	907.2	920.6	934.8	949.9	965.9	997.8
25-29	736.7	746.5	766.5	776.8	787.0	797.4	807.8	829.2
30-39	1285.0	1306.8	1346.2	1368.0	1389.7	1423.9	1442.9	1473.6
40-49	933.4	955.9	992.0	1014.7	1035.6	1060.5	1073.6	1107.7
50-59	587.8	604.5	629.7	647.2	664.9	682.9	701.2	729.4
60	416.9	435.1	459.9	479.3	499.3	519.8	540.7	569.8
Total	7950·0	8110.3	8384.2	8549.3	8713.8	8896.1	9052.7	9332.1

Annexure 8

Age group-wise Calorie Requirements for Tamil Nadu, District : Coimbatore

(million K. Cals. per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	441.4	438.9	434.3	434.5	434.9	435.4	436.1	437.0
3-5	798.4	802.3	803.4	806.7	808.7	809.7	809.5	808.2
6-9	887.7	912.8	938.2	948.7	954.4	955.3	951.6	942.9
10-14	1208.5	1251.4	1298.8	1338.3	1378.2	1418.5	1459.2	1500.3
15-19	1127.5	1145.7	1164.9	1196.4	1232.6	1273.0	1319.3	1369.8
20-24	1251.3	1266.7	1282.2	1301.1	1321.2	1342.0	1365.1	1388.9
25-29	1055.3	1069.4	1083.4	1097.8	1112.4	1127.0	1141.7	1156.5
30-39	1841.6	1871.8	1902.6	1933.5	1964.2	2012.5	2025.1	2055.3
40-49	1337.1	1369.2	1402.0	1434.1	1463.7	1498.3	1531.5	1541.8
50-59	841.9	865.8	889.9	914.7	939.8	965.2	991.1	1017.3
60 +	597.3	623.3	649.9	677.5	705.7	734.6	764.3	794.7
Total	11388.0	11617.3	11849.6	12083.3	12315.8	12573.2	12794.5	13012.7

Annexure 9

Age group-wise Calorie Requirements for Tamil Nadu, District : Nilgiris

(million K. Cals per day)

Age group	1979	1980	1981	1932	1983	1984	1985	1986
0-2	54.1	53.8	45.1	53.3	53.3	53.4	53.5	53 6
3 5	97.9	93.4	83.4	93.9	99.2	99,3	99.3	99.1
6-9	108,9	111.9	97.4	116.3	117.1	117.2	116.7	115.6
10-14	148.2	153.5	134.8	164.1	169.0	174.0	178.9	184.0
15-19	138.3	140.5	120.9	146.7	151.2	156,2	161.8	168.0
20-24	153.5	155.5	133.1	159.6	162.0	164.6	167.4	170.3
25-29	129.4	131.1	112.4	134.6	136.4	138.2	140.0	141.8
30-39	225.8	229.6	197.4	237.1	240.9	246.8	248.4	252.1
40-49	163.9	167.9	145.5	175.9	179.5	183.8	187.8	189.5
50-59	103.3	106.2	92.4	112.2	115.3	118.4	121.6	124 8
60- -	73.2	76.4	67.5	83.1	86.5	90.1	93.7	97 5
Total	1396.5	1424.6	1229.5	1481.8	1510.4	1542.0	1569.1	1596.3

Annexure 10

Age group-wise Calorie Requirements for Tamil Nadu, District : Madurai

(million K. Cals, per day)

Age Group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	395.6	393.4	389.2	389.4	389.8	390.2	390.9	387.5
3-5	715.5	719.0	720.1	722.9	724.8	725.6	725.5	716.7
6-9	795.6	818.1	840.8	850.2	855.4	850.2	852.8	830.2
10-14	1083.1	1121.5	1164.0	1199.4	1235.2	1271.3	1307.8	1330.5
15-19	1010.5	1023.8	1044.0	1072.3	1104.7	1141.4	1162.4	1214.7
20-24	1121.5	1135.2	1149.1	1160.1	1184.1	1203.3	1223.5	1231.7
25-29	915.8	958.4	971.0	983.9	996.9	1010.0	1023.2	1025.0
30-39	1650.5	1677.0	1705.2	1732.8	1760.3	1803.0	1814.9	1822.0
40-49	1198.3	1227.1	1256.5	1285.3	1131.8	1343.3	1372.6	1370.1
50-59	754.6	776.0	797.6	819.8	842.3	865.1	888.2	902.1
60+	535.3	558.6	582.5	607.2	632.4	658.4	684.9	704.7
Total	10206.3	10411.7	10620.0	10829.3	10857.7	11268.4	11466.7	11542.4

Annexure 11

Age group wise Calorie Requirements for Tamil Nadu-District : Tiruchirapalli

(Million K. Cals. Per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	378.9	381.0	372.8	373.0	369.3	369.7	370.3	366.9
3-5	685.4	690.3	689.7	692.5	680.7	687.4	687.3	678.6
6-9	762.1	792.3	805.4	814.4	810.4	811.2	807.9	791.7
10-14	1037.5	1080.1	1115.0	1148.9	1170.2	1204.4	1238.9	1259.7
15-19	968.0	994.4	1000.1	1027.1	1040.6	1081.4	1120.2	1150.1
20-24	1074.3	1099.4	1100.7	1026.0	1121.8	1139.9	1159.1	1160.2
25-29	905.9	928.1	930.1	942.5	944.5	956.9	969.4	971.1
30-39	1581.0	1624.6	1663.4	1659.9	1667.7	1708.7	1719.4	1725.6
40-49	1147.0	1188.4	1203.0	1231.2	1242.8	1272.6	1300.3	1297.2
50-59	722.8	751.5	764.0	785.2	797.9	819.5	841.5	854.1
60 +	512.7	541.0	558.0	581.6	599.1	623.7	648.9	667.2
Total	9775.0	10073.1	10202.8	10282.3	10457.0	10675.4	10863.2	10928.4

Annexure 12

Age group-wise Calorie Requirements in Tamil Nadu. District: Tanjavuru

(Million K. Cals. Per day)

Age Group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	378.9	372.7	368.7	364.8	365.1	365.6	366.2	362.8
3-5	685.4	681.2	682.2	667.3	679.0	679.8	679.7	670.9
6-9	702.1	775.1	796.6	796.5	801.3	802.1	798.9	782.8
10-14	1037.5	1002.5	1162.7	1123.7	1157.2	1191.0	1225.2	1245.5
15-19	967.9	972.8	989.1	1004.5	1034.9	1069.3	1107.7	1137.2
20-24	1074.3	1075.5	1088.6	1092.4	1109.3	1127.3	1146.2	1153.1
25-29	905.9	907.9	919.9	921.8	933.9	946.3	958.6	960.1
30-39	1581.0	1589.3	1615.4	1623.4	1649.2	1669.7	1700.3	1706.3
40-49	1147.9	1162.5	1190.4	1204.1	1228.9	1258.5	1285.9	1282.6
50-59	722.8	735.2	755.6	768.0	789.1	810.4	832.2	844.5
60+	512.7	529.2	551.9	568.8	592.5	616.8	641.7	659.7
Total	9776.4	9863.9	10061.1	10145.3	10340.4	10556.8	10742.6	10805.5

Annexure 13

Age group-wise Calorie Requirements in Tamil Nadu. District : Ramanathapuram

(Million K. Cals per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0- 2	287.3	285.8	282.7	282.8	283.1	283.4	283.9	284.5
3- 5	519.7	522.2	523.0	525.1	526.4	527.0	526.9	526.1
6- 9	577.9	594.2	610.7	617.5	621.3	621.9	619.4	613.8
10-14	786.7	814.6	845.4	871.2	891.1	923.4	949.9	976.6
15-19	733.9	745.8	758.3	778.8	802.4	829.0	858.8	891.7
20-24	814.6	824.6	834.6	846.9	860.1	878.9	888.6	904.1
25-29	686.3	696.1	705.2	714.6	724.1	736.6	743.2	752.8
30-39	1198.8	1218.5	1238.5	1258.6	1278.6	1310.0	1318.2	1337.0
40-49	870.4	891.3	912.6	933.5	952.8	975.6	996.9	1005.7
50-59	548.1	563.6	579.3	595.4	611.7	628.3	645.1	662.2
60 +	388.8	405.7	423.1	441.0	459.3	478.2	497.5	517.3
Total	7413.1	7562.4	7713.4	7865.4	8010.9	8184.3	8328.4	8472.7

Annexure 14

Age group-wise Calorie Requirements in Tamil Nadu. District : Tirunelveli*

(Million K. Cals per day)

Age Group	1979	1980	1981	1982	1983	1984	1985	1986
0- 2	312.3	310.6	307.3	303.3	303.6	303.0	300.4	300.9
3- 5	564.9	567.6	568.5	563.1	564.6	565.2	557.5	556.6
6- 9	628.1	645.9	663.8	662.3	666.3	666.9	655.3	649.4
10-14	855.1	885.4	918.9	934.3	962.1	990.3	1004.9	1033.2
15-19	797.8	810.7	824.2	835.2	860.5	889.1	903.6	943.4
20-24	885.4	896.2	907.2	908.3	922.4	937.0	940.1	956.5
25-29	746.7	756.6	766.6	766.4	776.5	786.3	786.3	796.5
30-39	1303.0	1324.4	1346.2	1349.8	1371.2	1404.9	1394.7	1415.4
40-49	946.1	968.8	992.0	1001.2	1021.8	1046.3	1054.7	1064.0
50-59	595.7	612.6	629.7	638.6	656.1	673.8	682.6	700.6
60+	422.6	441.0	459.9	472.9	492.8	512.8	526.3	547.3
Total	8057.7	8219.8	8384.3	8435.4	8597.7	8777.3	8811.4	8903.8

Annexure 15

Age group-wise Calorie Requirements in Tamil Nadu-District : Kanyakumari

(Million K. Cals. per day)

Age group	1979	1980	1981	1982	1983	1984	1985	1986
0-2	129.1	128.4	127.0	127.1	127.2	127.3	127.5	131.9
3-5	233.5	234.3	234.9	235.9	236.9	236.8	236.7	244.0
6-9	259.6	266.9	274.4	277.4	279.1	279.4	278.3	284.1
10-14	353.4	360.0	379.8	391.4	403.1	414.8	426.7	452.9
15-19	329.7	335.1	340.7	345.5	360.5	372.5	385.8	413.5
20-24	366.0	370.5	375.0	380.5	386.4	392.6	399.2	419.3
25-29	308.6	312.7	316.8	321.1	325.3	329.6	333.9	349.1
30-39	538.6	547.4	556.5	565.4	574.4	588.6	592.2	620.4
40-49	391.0	400.4	410.0	419.4	428.1	438.3	447.9	466.4
50-59	246.2	253.2	260.3	267.5	274.8	282.3	289.8	307.1
60 +	174.7	182.3	190.1	198.1	206.4	214.8	223.5	239.9
Total	3330.4	3397.5	3465.4	3533.8	3601.8	3677.0	3741.5	3929.2

Annexure 16

Age group-wise Requirements of Proteins for Tamil Nadu.

(Million Grams per day)

Age Group / Year	0-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	TOTAL
1979	65.2	110.4	153.5	234.0	245.2	212.1	195.0	328.3	251.0	174.3	145.2	2114.2
1980	64.9	111.0	157.9	242.3	249.1	214.7	192.5	333.7	257.0	179.3	151.5	2053.9
1981	64.2	111.1	162.2	251.5	253.3	217.4	195.1	339.2	263.2	184.3	158.0	2199.5
1982	64.2	111.6	164.1	259.1	260.1	220.0	197.7	344.7	269.2	189.4	164.7	2245.4
1983	64.3	111.9	165.1	266.8	268.0	224.0	200.3	350.2	274.7	194.6	171.6	2291.5
1984	64.4	112.0	165.2	274.9	277.0	227.6	202.9	358.8	281.3	199.8	178.6	2342.2
1985	64.5	112.0	164.6	282.5	286.9	231.4	205.6	361.0	287.5	205.2	185.8	2387.0
1986	64.6	111.8	163.1	290.5	297.8	235.5	208.2	366.4	293.6	210.6	193.2	2435.3

Requirements of Vitamin - A for Tamil Nadu (Million I. U per day)

Age Group / Year	0-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	TOTAL
1979	3470.3	6025.4	7444.3	13553.1	14085.9	12527.7	11469.6	19697.7	14998.8	10396·8	8695.2	122364.8
1980	3451.0	6054.8	7654.9	14033.8	13917.0	12681.3	11622.6	20021.4	15359.7	10691.7	9074.1	124562.3
1981	3414.1	6063.7	7867.3	14565.2	14150.4	12836.4	11775.0	20350.8	15727.5	10989.3	9462.6	127302.2
1982	3416.0	6088.1	7955.4	15008.1	14532.6	13025.7	11931.9	20680.8	16087.2	11294.7	9863.1	129883.6
1983	3419.0	6103.7	8003.5	15455.8	14972.7	13227.3	12089.7	21009.0	16419.3	11604.6	10273.5	132578.1
1984	3423.2	6110.6	8011.4	15907.9	15470.1	13440.3	12249.0	21525.6	16813.2	11918.7	10695.0	135565·0
1985	3428.7	6109.3	7979.5	16364.4	16025.7	13666.8	12408.9	21660.9	17179.5	12238.2	11126.7	138188.6
1986	3435.4	6099.4	7907.4	16825.2	16638.9	13905.0	12570.0	21983.4	17547.6	12561.6	11569.2	141043.1

Annexure 18

Age Group-wise Requirements of Iron for Tamil Nadu

(Million Mg. per day)

Age Group / Year	0-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	Total
1979	60.7	87.9	81.9	112.3	132.4	101.1	96.7	164.1	125.0	86.6	72.5	1120.4
1980	60.4	88.3	83.7	116.3	130.8	102.3	90.0	166.8	128.0	89.1	75.6	1139.4
1981	59.7	88.4	86.0	120.7	133.0	103.5	99.3	169.6	131.1	91.6	78.9	1161.8
1982	59.8	88.8	87.0	124.3	136.6	105.1	101.6	172.3	134.1	94.1	82.2	1102.7
1983	59.8	89.0	87.5	128.1	140.7	106.7	102.0	175.1	136.8	96.7	85.6	1208.0
1984	59.9	89.1	87.6	131.8	145.1	108.4	103.3	170.4	140.1	99.3	89.1	1233.1
1985	60.0	89.1	87.3	135.6	150.6	110.3	104.6	180.2	143.2	102.0	92.7	1255.6
1986	60.1	88.9	86.5	139.4	156.4	112.2	106.0	183.2	146.2	103.7	96.4	1280.0

Annexure 19

Age Group-wise Requirements of Calcium for Tamil Nadu

(Million Grams per day)

Age Group / Year	0-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	Total
1979	1.74	2.51	2.33	3.03	2.82	2.01	1.91	3.28	2.50	1.73	1.45	25.31
1980	1.73	2.52	2.39	3.14	2.78	2.11	1.94	3.34	2.56	1.78	1.51	25.80
1981	1.71	2.53	2.46	3.26	2.83	2.14	1.96	3.39	2.62	1.83	1.58	26.31
1982	1.71	2.54	2.49	3.35	2.91	2.17	1.99	3.45	2.68	1.88	1.64	26.81
1983	1.71	2.54	2.50	3.45	2.99	2.20	2.01	3.50	2.74	1.93	1.71	27.28
1984	1.71	2.55	2.50	3.56	3.01	2.24	2.04	3.59	2.80	1.99	1.78	27.77
1985	1.71	2.55	2.49	3.66	3.21	2.28	2.07	3.61	2.86	2.04	1.85	28.33
1986	1.72	2.54	2.47	3.76	3.33	2.32	2.10	3.66	2.92	2.09	1.93	28.84

Annexure 20

Age Group wise Vitamin-A Requirements for Children in Tamil Nadu

(Million I.U. per day)

Year	Madras			Chingleput			N. Arcot			S. Arcot			Dharmapuri		
	0-2	2-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total
1979	229.0	397.7	626.7	249.9	433.8	683.7	305.4	530.2	835.6	298.4	518.2	816.6	149.2	259.1	408.3
1980	231.2	405.7	636.9	248.5	435.9	684.4	303.7	532.8	836.5	293.3	514.7	808.0	148.4	260.4	408.8
1981	228.7	406.3	635.0	249.2	442.7	691.9	300.4	533.6	834.0	290.2	515.4	805.6	150.2	266.8	417.0
1982	232.3	414.0	646.3	249.4	444.4	693.8	297.2	529.7	826.9	290.4	517.5	807.9	150.3	267.9	418.2
1983	235.9	421.2	657.1	249.6	445.6	695.2	297.5	531.0	328.5	290.6	518.8	809.4	150.4	268.6	419.0
1984	235.6	427.7	663.3	249.9	446.1	696.0	297.8	531.6	829.4	287.5	513.3	800·8	150.6	268.9	419.5
1985	240.0	427.7	667.7	250.3	446.0	696.3	298.3	531.5	829·8	288.0	513.2	801.2	154.3	274.9	429.2
1986	243.9	433.1	677.0	254.2	451.3	705.5	295.4	524.6	820.0	288.6	512.3	800.6	154.6	274.5	429.1

Annexure 21

Age Groupwise Vitamin-A Requirements for Children in Tamil Nadu

[Million I.U. per day]

Year	Salem			Coimbatore			Nilgiris			Madurai			Tiruchurapalli		
	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total
1979	256.8	445.8	702.6	367.8	638.7	1006.5	45.1	78.3	123.4	329.7	572.4	902.1	315.8	548.3	864.1
1980	255.4	448.1	703.5	365.8	641.8	1007.6	44.9	78.7	123.6	327.8	575.2	903.0	317.5	557.0	874.5
1981	256.1	454.8	710.9	361.9	642.8	1004.7	37.6	76.7	114.3	324.3	576.1	900.4	310.7	551.8	862.5
1982	256.2	456.6	712.8	362.1	645.3	1007.4	44.4	79.1	123.5	324.5	578.4	902.9	310.9	554.0	865.9
1983	256.4	457.8	714.2	362.4	647.0	1009.4	44.5	79.3	123.8	324.8	579.9	904.7	307.7	549.3	857.0
1984	256.7	458.3	715.0	362.8	647.7	1010.5	44.5	79.4	123.9	325.2	580.5	905.7	308.1	549.9	858.0
1985	257.2	458.2	715.4	363.4	647.6	1011.0	44.6	79.4	124.0	325.7	580.4	906.1	308.6	549.8	858.4
1986	261.1	463.6	724.7	364.2	646.5	1010.7	44.7	79.3	124.0	322.9	573.3	896.2	305.6	542.8	848.4

Annexure 22

Age Groupwise Vitamin-A Requirements for Children in Tamil Nadu

(Million I.U. per day)

Year	Thanjavur			Ramanathapuram			Tirunelveli			Kanyakumari		
	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total
1979	315.8	548.3	864.1	239.5	415.7	655.2	260.3	451.9	712.2	107.6	186.8	294.4
1980	310.6	544.9	855.6	238.1	417.8	655.9	258.8	454.1	712.9	107.0	187.7	294.7
1981	307.3	545.9	853.2	235.6	418.4	654.0	256.1	454.8	710.9	105.8	188.0	293.8
1982	304.0	541.8	845.8	235.7	420.1	655.8	252.8	450.5	703.3	105.9	188.7	294.6
1983	304.3	543.2	847.5	235.9	421.2	657.1	253.0	451.7	704.7	106.0	189.2	295.2
1984	304.7	543.8	848.5	236.2	421.6	657.8	253.3	452.2	705.5	106.1	189.4	295.5
1985	305.2	543.7	848.9	236.6	421.6	658.2	250.3	446.0	696.3	106.3	189.4	295.7
1986	302.3	536.7	839.0	237.0	420.9	657.9	250.8	445.3	696.1	109.9	195.2	305.1

Annexure 23

Age Group-wise Iron Requirements for Children in Tamil Nadu

(Million Mg per day)

Year	Madras			Chingaleput			N. Arcot			S. Arcot			Dharmapuri		
	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total
1979	4.01	5.80	9.81	4.37	6.33	10.70	5.34	7.74	13.08	5.22	7.56	12.78	2.61	3.78	6.39
1980	4.05	5.92	9.97	4.35	6.36	10.71	5.32	7.77	13.09	5.13	7.51	12.64	2.60	3.80	6.40
1981	4.00	5.92	9.92	4.36	6.45	10.81	5.25	7.78	13.03	5.07	7.51	12.58	2.63	3.89	6.52
1982	4.07	6.04	10.11	4.37	6.48	10.85	5.20	7.73	12.93	5.08	7.55	12.63	2.63	3.91	6.54
1983	4.13	6.14	10.27	4.37	6.50	10.87	5.20	7.74	12.94	5.08	7.57	12.65	2.63	3.92	6.55
1984	4.19	6.24	10.43	4.37	6.50	10.87	5.21	7.75	12.96	5.03	7.48	12.51	2.64	3.92	6.56
1985	4.20	6.24	10.44	4.38	6.50	10.88	5.22	7.75	12.97	5.04	7.48	12.52	2.70	4.01	6.71
1986	4.27	6.31	10.58	4.45	6.58	11.03	5.17	7.65	12.82	5.05	7.47	12.52	2.70	4.00	6.70

Annexure 24

Age Group-wise Iron Requirements for Children in Tamil Nadu

(Million Mg per day)

Year	Salem			Coimbattore			Nilgiris			Madurai			Tiruchurapalli		
	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total
1979	4.49	6.50	10.99	6.43	9.32	15.75	0.79	1.14	1.93	5.77	8.35	14·12	5.52	8.00	13.52
1980	4.47	6.53	11.00	6.40	9.36	15.76	0.79	1.15	1.94	5.74	8.39	14.13	5·56	8.12	13.68
1981	4.48	6.68	11.11	6.33	9.37	15.70	0.66	0.97	1.63	5.67	8.40	14.07	5.43	8.04	13.47
1982	4.49	6.65	11.15	6.34	9.41	15·75	0.78	1.15	1.93	5.68	8.44	14.12	5.44	8.08	13.52
1983	4.49	6.68	11.17	6.34	9.43	15.77	0.78	1.16	1.94	5.68	8.46	14.14	5.38	8.01	13.39
1984	4.49	6.68	11.17	6.35	9.44	15·79	0.78	1.16	1.94	5.69	8.46	14.15	5.39	8.02	13·41
1985	4.50	6.68	11.18	6.36	9.44	15.80	0.78	1.16	1.94	5.70	8.46	14.16	5.40	8.02	13.42
1986	4.57	6.76	11.33	6.37	9.42	15.79	0.78	1.16	1.94	5.71	8.45	14.16	5.35	7.91	13.26

Annexure 33

Food Gaps between Requirements and Consumption in Tamil Nadu : District : Nilgiris

('000 tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	6.5	5.0	-8.9	2.0	0.3	-1.5	-3.3	-5.3
	(8.4)	(6.3)	(-13.1)	(2.4)	(0.3)	(-1.7)	(-3.8)	(-6.0)
All cereals	11.6	1.4	-8.5	6.8	5.1	3.1	1.4	-0.7
	(11.0)	(1.3)	(-9.1)	(6.1)	(4.5)	(2.7)	(1.2)	(-0.6)
Grams and	0.3	0.2	-0.9	0	0	0.1	-0.3	-0.3
pulses	(4.8)	(3.3)	(-16.7)	(0)	(0)	(1.4)	(-4.3)	(-4.2)
Vegetables	2.2	1.8	-0.8	2.3	11.8	1.4	2.2	1.8
	(17.6)	(16.8)	(-7.8)	(16.8)	(13.2)	(10.3)	(14.9)	(12.2)
Fruits	12.0	12.6	7.9	13.7	14.4	15.2	15.8	16.5
	(36.4)	(37.4)	(27.1)	(39.1)	(40.3)	(41.6)	(42.6)	(43.7)
Milk	-1.3	-1.2	-3.9	-1.2	-1.2	-1.2	-1.1	-1.1
	(-7.7)	(-6.8)	(-25.6)	(-6.2)	(-6.5)	(-6.3)	(-5.7)	(-5.6)
Starchy foods	4.6	4.1	2.1	3.5	3.3	2.8	2.5	2.0
	(40.7)	(35.6)	(21.2)	(29.2)	(27.0)	(22.4)	(19.7)	(15.5)
Sugar	-2.9	-3.4	-5.9	-4.1	-4.5	-5.0	-5.5	-6.0
	(-21.5)	(-24.8)	(-50.0)	(-28.7)	(-30.8)	(-33.5)	(-36.4)	(-38.9)
Fish	0.9	1.0	0.1	1.0	1.0	0.9	1.1	1.2
	(17.0)	(17.8)	(2.1)	(17.2)	(16.9)	(15.0)	(18.0)	(19.4)

Figures in brackets are percentage of gap to total requirement

Annexure 34

Food Gaps between Requirements and Consumption in Tamil Nadu District : Madurai

('000 tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	30.7	23.5	16.1	9.3	-9.8	-7.4	-15.8	-32.1
	(5.4)	(4.1)	(2.7)	(1.6)	(-1.6)	(-1.2)	(-2.5)	(-5.0)
Cereals	62.1	56.1	49.5	43.9	21.8	28.8	21.2	3.1
	(8.1)	(7.1)	(6.2)	(5.4)	(2.7)	(3.4)	(2.4)	(0.3)
Grams and pulses	0.7	0.3	0.2	-0.2	-1.4	-1.0	-1.3	-2.2
	(1.6)	(0.7)	(0.4)	(-0.4)	(-2.9)	(-2.0)	(-2.6)	(-4.3)
Vegetables	15.3	15.5	14.7	14.9	12.5	13.7	13.9	12.8
	(16.4)	(16.2)	(15.2)	(15.0)	(12.6)	(13.5)	(13.3)	(12.1)
Fruits	82.7	88.1	93.6	99.4	100.7	111.3	117.1	120.2
	(34.3)	(35.8)	(37.3)	(38.8)	(39.2)	(41.7)	(43.2)	(44.0)
Milk	-13.5	-12.5	-11.2	-13.1	-11.3	-7.5	-6.2	-6.4
	(-9.7)	(-9.7)	(-8.5)	(-10.0)	(-8.4)	(-5.4)	(-4.4)	(-4.5)
Starchy foods	31.9	29.0	28.2	25.2	22.4	20.9	19.5	15.1
	(38.5)	(34.4)	(32.7)	(28.7)	(25.5)	(22.9)	(20.9)	(16.1)
Sugar	-25.4	-27.4	-29.4	-31.3	-35.5	-35.9	-38.1	-48.1
	(-25.8)	(-27.3)	(-28.7)	(-29.9)	(-33.9)	(-33.1)	(-34.5)	(-37.6)
Fish	6.0	6.2	6.4	6.6	8.0	7.0	9.1	8.8
	(15.0)	(15.2)	(15.4)	(15.6)	(14.2)	(15.9)	(20.3)	(19.5)

Figures in brackets are percentages of gap to total requirement

Annexure 35

Food Gaps between Requirements and Consumption in Tamil Nadu District : Tiruchirapalli

('000 tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	27.2	27.4	18.4	-6.0	-3.8	-10.1	-16.5	-31.3
	(5.0)	(4.9)	(3.4)	(-1.1)	(-0.7)	(-1.7)	(-2.8)	(-5.2)
Cereals	57.1	60.4	51.4	35.4	28.3	23.4	17.7	1.8
	(7.7)	(7.9)	(6.6)	(4.6)	(3.6)	(2.9)	(2.2)	(0.2)
Grams and pluses	0.5	1.2	0.4	-0.5	-0.8	-1.2	-1.4	-2.1
	(1.0)	(2.7)	(0.9)	(-1.1)	(-1·7)	(-2.5)	(-2.9)	(-4.3)
Vegetables	13.8	15.3	14.6	14.0	13.1	13.5	12.7	12.0
	(15.5)	(16.6)	(15.6)	(14.8)	(13.7)	(13.8)	(12.8)	(11.9)
Fruits	105.5	86.6	91.0	93.1	98.4	104.7	110.5	113.6
	(45.6)	(36.3)	(37.6)	(38.3)	(39.8)	(41.5)	(43.0)	(43·9)
Milk	-13.4	-10.9	-10.1	-10.6	-9.5	-7.8	-6.3	-6.3
	(-11.2)	(-8.7)	(-8.0)	(-8.4)	(-7.4)	(-5.9)	(-4.7)	(-4.7)
Starchy foods	30.3	28.7	27.4	23.5	22.2	19.5	18.3	14.3
	(38.2)	(35.1)	(33.0)	(28.2)	(26.2)	(22.5)	(20.8)	(16.1)
Sugar	-24.7	-25.4	-27.6	-30.0	-33.1	-34.7	-36.5	-39.7
	(-26.2)	(-26.1)	(-28.0)	(-30.2)	(-32.9)	(-33.7)	(-34.9)	(-37.8)
Fish	5.6	6.3	6.2	6.0	6.1	6.4	8.3	8.3
	(14.7)	(16.0)	(15.5)	(14.9)	(14.9)	(15.3)	(19.8)	(19.4)

Figures in brackets are percentage of gap to total requirements

Annexure 36

Food Gaps between Requirements and Consumption in Tamil Nadu District: Tanjavur

('000 tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-33	1983-84	1984-85	1985-86	1986-87
Rice	31.7	20.2	14.7	2.5	-3.6	-9.2	-15.6	-29.5
	(5.8)	(3.7)	(2.6)	(0.4)	(-0.6)	(-1.6)	(-2.6)	(-4.9)
Cereals	63.0	-50.4	65.4	33.0	28.1	23.9	18.9	3.6
	(8.5)	(6.8)	(8.6)	(4.3)	(3.4)	(3.0)	(2.3)	(0.4)
Grams and pulses	0.9	0.3	0.1	-0.7	-0.8	-1.1	-1.3	-2.0
	(2.1)	(0.7)	(0.2)	(-1.6)	(-1.7)	(-2.4)	(-2.7)	(-4.2)
Vegetables	15.5	13.7	14.4	12.5	12.9	13.4	12.8	12.0
	(17.2)	(15.2)	(15.6)	(13.5)	(13.6)	(13.8)	(13.1)	(12.1)
Fruits	79.8	82.8	88.5	91.4	97.4	103.7	109.6	112.7
	(34.5)	(35.5)	(37.2)	(38.1)	(39.8)	(41.5)	(43.1)	(44.1)
Milk	-12.3	-12.4	-10.7	-10.8	-9.3	-7.6	-6.0	-5.9
	(-10.2)	(-10.2)	(-8.6)	(-8.6)	(-3.7)	(-5.8)	(-4.5)	(-4.4)
Starchy foods	30.7	27.4	26.6	23.0	22.0	19.3	18.2	14.3
	(38.8)	(34.3)	(32.6)	(28.0)	(26.2)	(22.6)	(20.9)	(16.3)
Sugar	-23.7	-26.4	-27.9	-30.8	-32.5	-34.2	-35.9	-39.0
	(-25.2)	(-27.8)	(-28.7)	(-31.4)	(-32.6)	(-33.6)	(-34.7)	(-37.5)
Fish	5.9	6.2	6.0	5.8	6.1	6.4	3.5	8.5
	(15.4)	(16.1)	(15.3)	(14.6)	(15.1)	(15.5)	(20.2)	(19.7)

Figures in brackets are percentage of gap to total requirement

Annexure 37

Food Gaps between Requirements and Consumption in Tamil Nadu

District : Ramanathapuram ('000 tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	20.5	14.9	9.3	3.4	-3.1	-8.6	-15.1	-22.4
	(4.9)	(3.6)	(2.2)	(0.8)	(-0.7)	(-1.9)	(-3.3)	(-4.8)
Cereals	43.1	38.0	32.8	27.5	21.4	16.7	10.7	3.7
	(7.7)	(6.6)	(5.6)	(4.6)	(3.5)	(2.7)	(1.7)	(0.6)
Grams and pulses	0.3	0.1	0	-0.4	-0.6	-1.0	-1.2	-1.5
	(0.9)	(0.3)	(0)	(-1.2)	(-1.7)	(-2.7)	(-3.3)	(-4.0)
Vegetables	10.3	10.9	10.5	11.1	9.6	10.3	9.8	9.3
	(15.3)	(15.7)	(14.9)	(15.4)	(13.2)	(13.7)	(12.8)	(12.0)
Fruits	59.5	63.4	67.3	71.3	74.9	80.0	84.1	88.5
	(33.9)	(35.4)	(36.9)	(38.3)	(39.6)	(41.3)	(42.7)	(44.2)
Milk	-10.2	-9.6	-8.7	-8.1	-7.3	-6.3	-6.2	-4.4
	(-11.1)	(-10.3)	(-9.1)	(-8.4)	(-7.4)	(-6.2)	(-6.3)	(-4.2)
Starchy foods	23.0	21.0	20.2	18.0	17.0	14.8	13.8	11.3
	(38.3)	(34.2)	(32.3)	(28.2)	(26.2)	(22.3)	(20.4)	(16.4)
Sugar	-18.8	-30.3	-21.9	-23.5	-25.2	-26.8	-28.5	-30.4
	(-26.3)	(-48.2)	(-29.5)	(-31.0)	(-32.6)	(-33.9)	(-35.5)	(-37.2)
Fish	4.2	4.3	4.4	4.6	4.7	4.8	6.3	6.5
	(14.5)	(14.6)	(14.6)	(15.0)	(15.0)	(15.0)	(19.4)	(19.6)

Figures in brackets are precentage of gap to total requirement

Annexure 38

Food Gaps between Requirements and Consumption in Tamil Nadu District : Tirunelveli

(000' tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	23.0	18.7	15.4	3.5	1.3	-5.0	-17.4	-26.0
	(5.2)	(4.1)	(3.3)	(0.7)	(-0.3)	(-1.0)	(-3.6)	(-5.3)
Cereals	47.9	44.4	41.2	29.4	25.6	22.4	9.7	-0.8
	(7.8)	(7.1)	(6.5)	(4.6)	(3.9)	(3.4)	(1.5)	(-0.1)
Grams & pulses	0.5	0.4	0.2	-0.4	-0.6	-0.7	-1.4	-1.7
	(1.4)	(1.1)	(0.5)	(-1.1)	(-2.0)	(-1.8)	(-3.6)	(-4.3)
Vegetebles	12.3	11.9	11.6	12.8	10.9	10.6	10.6	9.9
	(16.6)	(15.8)	(15.2)	(16.5)	(13.9)	(13.3)	(12.7)	(12.1)
Fruits	65.0	69.5	74.4	76.4	81.5	86.7	88.8	92.6
	(34.1)	(35.7)	(37.5)	(38.2)	(40.1)	(41.8)	(42.6)	(43.9)
Milk	-11.0	-9.8	-8.5	-8.6	-7.3	-5.8	-6.0	-5.2
	(-11.1)	(-9.7)	(-8.2)	(-8.3)	(-6.9)	(-5.3)	(-5.5)	(-4.7)
Starchy food	25.1	23.0	22.3	19.3	18.5	16.3	14.5	11.5
	(38.4)	(34.5)	(32.8)	(28.2)	(26.5)	(22.9)	(20.3)	(15.9)
Sugar	-20.3	-21.6	-22.8	-25.2	-28.1	-28.0	-30.5	-32.5
	(-26.2)	(-27.3)	(-28.2)	(-31.0)	(-33.9)	(-33.1)	(-35.9)	(-37.8)
Fish	4.7	4.9	5.1	4.9	5.2	5.4	6.6	6.7
	(14.9)	(15.3)	(15.6)	(14.9)	(15.5)	(15.7)	(19.2)	(19.3)

Figures in brackets are percentage of gap to total requirement

Annexure 39

Food Gaps between Requirements and Consumption in Tamil Nadu District : Kanyakumari

(000' tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	11.0	8.1	4.7	1.7	-1.8	-5.2	-10.2	-7.5
	(5.9)	(4.3)	(2.4)	(0.8)	(-0.9)	(-2.5)	(-4.9)	(-3.4)
Cereals	22.0	19.0	15.8	12.3	8.7	5.0	1.5	6.4
	(9.7)	(7.4)	(6.0)	(4.6)	(3.2)	(1.8)	(0.4)	(2.1)
Grams and pulses	7.3	0.2	0	-0.3	-0.3	-0.6	-0.8	-0.4
	(2.0)	(1.3)	(0)	(-1.9)	(-1.9)	(-3.7)	(-4.8)	(-2.3)
Vegetables	5.5	4.7	6.0	4.2	4.4	4.8	4.0	5.4
	(17.8)	(15.2)	(15.7)	(13.1)	(13.3)	(14.0)	(11.7)	(14.7)
Fruits	27.2	28.9	30.4	32.0	33.7	35.5	37.2	41.8
	(34.5	(35.9)	(37.1)	(38.3)	(39.5)	(40.8)	(42.0)	(44.9)
Milk	-3.9	-4.0	-3.7	-3.6	-3.5	-3.2	-3.4	-1.2
	(-9.5)	(-9.5)	(-8.6)	(-8.2)	(-7.9)	(-7.0)	(-7.3)	(-2.5)
Starchy food	10.4	9.6	9.2	8.1	7.6	6.5	5.9	5.6
	(38.6)	(34.9)	(32.7)	(28.3)	(26.0)	(21.8)	(19.5)	(17.6)
Sugar	-7.9	-8.8	-9.7	-10.5	-11.5	-12.5	-13.4	-13.2
	(-24.6)	(-26.9)	(-29.1)	(-30.8)	(-33.1)	(-35.3)	(-37.1)	(-34.8)
Fish	2.1	2.5	2.0	2.4	2.1	2.0	2.7	3.2
	(16.1)	(18.2)	(14.8)	(17.4)	(14.9)	(14.0)	(18.5)	(20.9)

Figures in brackets are percentages of gap to total requirement

Annexure 25

Age Group-wise Iron Requirements for Children in Tamil Nadu

(Million Mg Per day)

	Thanjavur			Ramanathapuram			Tirunelveli			Kanyakumari		
Year	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total	0-2	3-5	Total
1979	5.52	8.00	13.52	4.19	6.07	10.26	4.55	6.59	11.14	1.88	2.72	4.60
1980	5.44	7.95	13.39	4.17	6.09	10.26	4.53	6.62	11.15	1.87	2.74	4.61
1981	5.37	7.96	13.33	4.12	6.10	10.22	4.48	6.63	11.11	1.85	2.74	4.59
1982	5.32	7.90	13.22	4.13	6.13	10.26	4.43	6.57	11.00	1.85	2.75	4.60
1983	5.32	7.92	13.24	4.13	6.14	10.27	4.43	6.59	11.02	1.85	2.76	4.61
1984	5.33	7.93	13.26	4.13	6.15	10.28	4.43	6.59	11.02	1.86	2.76	4.62
1985	5.34	7.93	13.27	4.14	6.15	10.29	4.38	6.50	10.88	1.86	2.76	4.62
1986	5.29	7.82	13.11	4.15	6.13	10.28	3.39	6.49	9.88	1.92	2.85	4.77

Annexure 26

Food Gaps Between Requirements and Consumption in Tamil Nadu

District: Madras

000' tons

Year / Commodity	1979-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87
Rice	22.0	18.5	8.3	3.7	-1.0	-5.7	-12.9	-24.4
	(5.6)	(4.5)	(2.0)	(0.9)	(-0.2)	(-1.2)	(-2.7)	(-5.0)
Cereals	44.5	42.0	30.9	27.8	24.3	20.9	14.4	2.1
	(8.3)	(7.6)	(5.5)	(4.7)	(4.0)	(3.3)	(2.2)	(0.3)
Grams and pulses	0.5	0.4	-0.1	-0.3	-0.5	-0.8	-1.0	-1.6
	(1.6)	(1.2)	(-0.3)	(-0.9)	(-1.4)	(-2.2)	(-2.6)	(-4.2)
Vegetables	10.9	11.0	10.0	10·0	9.9	11.0	10.9	9.5
	(16.7)	(16.3)	(14.6)	(14.1)	(13.6)	(14.4)	(13.8)	(11.9)
Fruits	57.4	62.4	65.0	70.2	75.7	81.7	86.7	90.5
	(34.2)	(35.9)	(36.7)	(38.3)	(39.9)	(41.6)	(43.3)	(43.9)
Milk	-9.4	-8.6	-8.9	-8.1	-7.1	-5.9	-5.2	-5.2
	(-10.0)	(-9.5)	(-9.7)	(-8.5)	(-7.2)	(-5.8)	(4.9)	(-4.8)
Starchy foods	22.2	20.8	19.5	17.8	17.0	15.5	14.5	11.4
	(38.6)	(34.9)	(32.1)	(28.3)	(26.2)	(23.0)	(20.9)	(16.1)
Sugar	-17.4	-18.9	-21.4	-23.0	-24.8	-26.5	-30.0	-33.0
	(-25.5)	(-26.7)	(-29.6)	(-30.7)	(-32.1)	(-33.1)	(-36.4)	(-39.2)
Fish	3.9	4.2	4.1	4.3	4.5	4.8	6.3	6.2
	(14.2)	(14.8)	(14.1)	(14.3)	(14.5)	(14.9)	(19.1)	(18.4)

Figures in brackets are percentage of gap to total requirement

Annexure 27

Food Gaps Between Requirements and Consumption in Tamil Nadu

District : Chingleput (000' tons)

Year Commodity	1979-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87
Rice	22.4	15.2	13.8	6.0	-2.3	-10.2	-18.8	-21.7
	(5.2)	(3.5)	(3.1)	(1.3)	(-0.5)	(-2.1)	(-3.8)	(-4.3)
Cereals	46.3	39.0	39.9	32.3	24.1	16.3	7.7	7.1
	(7.9)	(6.5)	(6.5)	(5.1)	(3.7)	(1.7)	(1.2)	(1.0)
Grams and pulses	0.4	0.1	0.2	-0.3	-0.7	-1.1	-1.5	-1.5
	(1.2)	(0.3)	(0.6)	(-0.8)	(-1.9)	(-2.8)	(-3.8)	(-3.7)
Vegetables	11.4	10.6	11.2	11.5	10.8	10.1	10.2	10.4
	(16.1)	(14.7)	(15.1)	(15.1)	(13.9)	(12.8)	(12.6)	(12.5)
Fruits	62.2	65.7	71.9	75.8	79.7	84.0	88.1	95.1
	(34.0)	(35.2)	(37.3)	(38.6)	(39.8)	(41.0)	(42.3)	(44.3)
Milk	-10.7	-10.4	-8.6	-8.2	-7.8	-7.1	-6.5	-4.5
	(-11.2)	(-10.7)	(-8.6)	(-8.1)	(-7.5)	(-6.7)	(-6.0)	(-4.0)
Starchy foods	24.1	21.8	21.8	19.3	18.0	15.6	14.3	12.3
	(38.4)	(34.1)	(32.9)	(28.6)	(26.2)	(22.2)	(20.0)	(16.7)
Sugar	-19.4	-21.3	-22.3	-24.3	-26.4	-28.6	-32.3	-33.5
	(-26.0)	(-28.0)	(-28.4)	(-30.2)	(-32.3)	(-34.3)	(-38.0)	(-38.2)
Fish	4.2	4.2	4.7	4.7	4.7	4.8	6.3	6.7
	(14.0)	(13.8)	(14.8)	(14.6)	(14.3)	(14.3)	(18.5)	(19.1)

Figures in brackets are precentage of gap to total requirement

Annexure 28

Food Gaps Between Requirements and Consumption in Tamil Nadu : District : North Arcot

(000' tonnes)

Year / Commodity	1979-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87
Rice	26.0	20.6	15.1	3.1	-3.0	-8.5	-14.7	-56.2
	(5.0)	(3.8)	(2.8)	(0.6)	(-0.5)	(-1.5)	(-2.5)	(-16.1)
Cereals	54.6	50.4	46.1	33.2	28.3	24.1	19.2	-33.9
	(7.7)	(6.9)	(6.2)	(4.4)	(3.7)	(3.1)	(2.4)	(-4.4)
Grams & pulses	0.4	0.4	0.2	-0.6	-0.8	-1.1	-1.3	-4.1
	(1.0)	(0.9)	(0.5)	(-1.4)	(-1.8)	(-2.4)	(-2.8)	(-9.2)
Vegetables	12.9	13.3	14.0	13.3	12.6	13.1	12.5	7.2
	(15.1)	(15.1)	(15.5)	(14.6)	(13.6)	(13.8)	(13.1)	(7.8)
Fruits	75.5	80.8	86.4	89.3	95.0	101.1	106.8	98.1
	(33.8)	(35.4)	(37.2)	(38.1)	(39.7)	(41.4)	(43.1)	(41.2)
Milk	-13.4	-12.2	-10.7	-10.7	-9.4	-7.7	-6.2	-12.1
	(-11.5)	(-10.3)	(-8.8)	(-8.8)	(-7.6)	(-6.1)	(-4.8)	(-9.8)
Starchy food	29.3	26.9	26.0	22.6	21.6	19.0	17.9	9.9
	(38.2)	(34.4)	(32.6)	(28.1)	(26.3)	(22.7)	(21.0)	(12.1)
Sugar	-24.0	-26.3	-27.2	-29.9	-31.7	-33.3	-36.7	-44.6
	(-26.3)	(-28.5)	(-28.7)	(-31.3)	(-32.5)	(-33.5)	(-36.3)	(-46.0)
Fish	5.0	5.3	5.6	5.3	5.0	5.9	7.9	5.8
	(13.7)	(14.2)	(14.7)	(13.8)	(14.3)	(14.8)	(19.4)	(14.9)

Figures in brackets are percentage of gap to total requirement

Annexure 29

Food Gaps Between Requirements and Consumption in Tamil Nadu : District : South Arcot

(000' tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	20.5	18.7	13.1	7.3	1.3	-10.8	-17.0	-24.2
	(4.1)	(3.6)	(2.5)	(1.4)	(0.2)	(-1.9)	(-3.0)	(-4.2)
Cereals	46.8	47.1	42.5	38.0	33.1	19.9	14.8	8.7
	(6.8)	(6.7)	(5.9)	(5.2)	(4.4)	(2.6)	(1.9)	(1.2)
Grams and pluses	0.1	0.2	0	-0.2	-0.4	-1.2	-1.4	-1.6
	(0.3)	(0.5)	(0)	(-0.5)	(-0.9)	(-2.7)	(-3.1)	(-3.5)
Vegetables	12.9	13.4	12.9	13.4	-12.8	12.2	11.6	12.1
	(15.5)	(15.7)	(14.9)	(15.1)	(14.3)	(13.3)	(12.6)	(12.7)
Fruits	71.1	77.8	83.1	88.4	93.3	97.1	102.5	108.1
	(33.2)	(35.3)	(37.0)	(38.0)	(40.2)	(41.2)	(42.8)	(44.4)
Milk	-14.1	-12.1	-10.7	-9.4	-8.1	-8.0	-6.4	-5.1
	(-12.6)	(-10.5)	(-9.1)	(-7.9)	(-6.7)	(-6.5)	(-5.1)	(-4.0)
Starchy foods	27.6	25.9	25.1	22.5	21.6	18.0	16.9	14.1
	(37.6)	(34.3)	(32.6)	(28.6)	(27.0)	(22.3)	(20.6)	(16.8)
Sugar	-24.0	-25.0	-26.0	-28.2	-29.9	-32.7	-36.1	37.9
	(-27.4)	(-27.8)	(-28.9)	(-23.2)	(-31.4)	(-34.0)	(-36.9)	(38.1)
Fish	4.6	5.0	5.2	5.5	5.8	5.5	7.4	7.7
	(13.1)	(13.9)	(14.1)	(14.6)	(15.2)	(14.3)	(18.8)	(19.2)

Figures in brackets are percentage of gap to total requirements

Annexure 30

Food Gaps between Requirements and Consumption in Tamil Nadu

District : Dharmapuri

(000' tonnes)

Year / Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	13.3	8.6	9.8	4.4	-1.5	-7.2	-6.9	-8.2
	(5.2)	(3.3)	(3.6)	(1.6)	(-0.5)	(-2.5)	(-2.3)	(-2.6)
Cereals	27.4	22.7	26.1	20.5	14.4	8.4	10.8	11.1
	(7.9)	(6.4)	(7.0)	(5.4)	(3.7)	(2.1)	(2.6)	(2.6)
Grams and pulses	0.1	0.1	0.3	-0.1	-0.3	-0.8	-0.6	-0.5
	(0.4)	(0.5)	(1.4)	(-0.5)	(-1.3)	(-3.5)	(-2.5)	(-2.0)
Vegetables	6.0	6.8	6.7	6.6	6.4	6.3	7.2	7.0
	(16.3)	(15.7)	(15.1)	(14.4)	(13.7)	(13.1)	(14.4)	(13.6)
Fruits	37.0	39.1	43.8	45.9	48.1	50.4	55.5	60.1
	(34.0)	(35.2)	(37.7)	(38.7)	(39.8)	(40.9)	(43.2)	(45.2)
Milk	-6.4	-6.3	-4.7	-4.7	-4.7	-4.5	-3.0	-1.6
	(-11.3)	(-10.9)	(-7.7)	(-7.6)	(-7.5)	(-7.0)	(-4.5)	(-2.3)
Starchy foods	14.4	13.0	13.2	11.7	10.9	9.3	9.4	8.3
	(38.6)	(34.1)	(33.1)	(28.8)	(26.3)	(21.9)	(21.3)	(18.2)
Sugar	-11.6	-12.8	-13.0	-14.5	-15.9	-17.5	-18.8	-19.6
	(-26.2)	(-28.2)	(-27.4)	(-30.0)	(-32.2)	(-34.8)	(-35.9)	(-36.1)
Fish	2.5	2.5	2.9	2.9	2.9	2.9	4.1	4.5
	(14.0)	(13.7)	(15.2)	(14.9)	(14.6)	(14.3)	(19.5)	(20.6)

Figures in brackets are percentages of gap to total requirement

Annexure 31

Food Gaps between Requirements and Consumption in Tamil Nadu District : Salem

(000' tonnes)

Year Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	22.5	15.4	14.0	6.3	-1.9	-9.6	-18.4	-21.0
	(5.1)	(3.4)	(3.0)	(1.3)	(-0.4)	(-1.9)	(-3.7)	(-4.1)
Cereals	46.9	39.8	40.8	33.4	25.1	17.8	9.0	8.4
	(7.8)	(6.5)	(6.4)	(5.2)	(3.8)	(2.6)	(1.3)	(1.2)
Grams and pulses	0.5	0.1	0.2	-0.3	-0.6	-1.0	-1.5	-1.4
	(1.4)	(0.3)	(0.5)	(-0.8)	(-1.6)	(-2.5)	(-3.7)	(-3.4)
Vegetables	11.9	11.2	11.7	12.1	11.2	10.3	10.7	10.9
	(16.3)	(15.2)	(15.3)	(15.4)	(14.0)	(12.7)	(12.8)	(12.7)
Fruits	63.7	67.4	73.9	77.8	82.0	86.5	90.7	97.9
	(33.9	(35.2)	(37.3)	(38.5)	(39.8)	(41.2)	(42.2)	(44.4)
Milk	-11.1	-10.7	-8.7	-8.3	-7.9	-7.1	-6.4	-4.4
	(-11.3)	(-10.7)	(-8.4)	(-7.9)	(-7.4)	(-6.5)	(-5.7)	(-3.8)
Starchy food	24.7	22.4	22.3	19.9	18.7	16.1	14.7	12.3
	(38.3)	(34.1)	(32.8)	(28.7)	(26.5)	(22.3)	(20.0)	(16.9)
Sugar	-20.0	-22.0	-22.9	-24.9	-27.1	-29.2	-32.9	-34.2
	(-26.1)	(-28.1)	(-28.3)	(-30.2)	(-32.3)	(-34.1)	(-37.7)	(-38.0)
Fish	4.2	4.8	4.8	4.9	4.9	5.0	6.5	7.0
	(13.7)	(13.7)	(14.8)	(14.8)	(14.5)	(14.5)	(18.6)	(19.4)

Figures in brackets are percentages of gap to total requirement

Annexure 32

Food Gaps Between Requirements and Consumption in Tamil Nadu: Disttrict: Coimbatore

000' tons

Year / Commodity	1979-80	80-81	81-82	82-33	83-84	84-85	85-86	86-87
Rice	34.4	25.9	17.1	7.9	-1.6	-10.9	-20.9	-32.3
	(5.4)	(4.0)	(2.6)	(1.2)	(-0.2)	(-1.5)	(-2.0)	(-4.5)
Cereals	70.2	62.2	54.1	45.9	37.0	28.8	19.4	8.5
	(8.1)	(7.1)	(6.0)	(5.0)	(4.0)	(3.0)	(2.0)	(0.9)
Grams and pulses	0.8	0.5	0.1	-0.5	-0.8	-1.3	-1.8	-2.2
	(1.6)	(1.0)	(0.2)	(-0.9)	(-1.5)	(-2.3)	(-3.2)	(-3.8)
Vegetables	16.6	16.4	16.5	16.2	15.9	14.6	15.6	15.3
	(16.0)	(15.5)	(15.2)	(14.6)	(14.1)	(12.8)	(13.3)	(12.8)
Fruits	91.9	97.7	103.8	109.8	116.1	123.1	129.4	135.9
	(34.2)	(35.6)	(37.1)	(38.5)	(39.9)	(41.5)	(42.8)	(44.2)
Milk	-15.4	-14.5	-13.2	-12.1	-10.9	-9.5	-8.1	-6.8
	(-11.0)	(-10.1)	(-9.0)	(-8.1)	(-7.2)	(-6.1)	(5.1)	(-4.2)
Starchy foods	35.6	32.5	31.2	28.0	26.5	23.0	21.5	17.5
	(38.5)	(34.5)	(32.5)	(28.6)	(26.5)	(22.6)	(20.7)	(16.6)
Suger	-28.2	-30.6	-33.0	-35.5	-38.0	-40.7	-43.3	-46.2
	(-25.7)	(-27.3)	(-28.8)	(-30.5)	(-32.0)	(-33.6)	(-35.1)	(-36.8)
Fish	6.2	6.4	6.6	6.8	7.2	7.1	9.4	9.6
	(14.1)	(14.2)	(14.4)	(14.6)	(15.1)	(14.6)	(18.9)	(19.1)

Figures in brackets are percentage of gap to total requirement

Child Nutrition

2

1

Children as a Vulnerable Age-group

Although the value system of a society ultimately governs the treatment it accords to the vulnerable groups, it may be noted that a sense of inter-generational transfer of various types of resources is a useful characteristic determining the economic and non-economic investments for proper development of children. Unlike many other segments of population, children cannot be expected to effectively voice their long-run interests; hence it is the primary duty of the society to look after their needs and welfare.

At a disaggregate level, hunger and malnutrition in children collectively and individually affect the chances of survival, physical and mental growth. Malnutrition in children in developing countries is a major disinvestment. The liabilities in the forms of high mortality and morbidity, lower physical ability, and physical and mental handicaps lead to considerable drain on the public resources of a nation in the long-run, thus structurally hampering the progress of a nation.

The subsequent paragraphs, in this section, provide the empirical data in respect of infant and child mortality, role of nutrition deficiencies, and identify factors influencing the health and nutrition status. Economic growth alone is not a sufficient condition for alleviating child nutrition problems, as will be noted in the subsequent paragraphs. Special attention is called for, and the subsequent sections, with the aid of empirical analysis, throw some light on the intervention policies.

There are a number of human, social, and economic reasons justifying assigning immense preference for properly developing children, and especially improving child nutrition. The humanitarian aspect, therefore, does not need elaboration. Some of the socio–economic aspects, however, are briefly discussed in this report. It is desirable thus to review the relevant statistics relating to child mortality, morbidity, and nutrition in the Indian context with a view to specifically highlighting the relevance and urgency so as to improve child nutrition.

Tables 1 and 2 relating to all-India averages indicate that 25 per cent of deaths in the age-group of 0–60 months occur in the first twelve months. As much as 86 per cent is accounted for in the age–group 0 to 36 months. Evidently, this is the age-group that needs concentration, since many of the deaths are attributable to nutrition deficiencies of pregnant/lactating mothers and children, belonging to this age-group.

Table 1: All India Average Death Rates

Age in years	Percentage of total population	Percentage of total deaths
0–1	3	27
1–4	11	19
5–14	25	8
15–49	49	16
50	12	30
Total	100	100

Source : a) Calculations are based on all-India projected population for mid-year 1978.

b) Infant deaths are calculated from Ashok Mitra. *India's Population*. New Delhi, Abhinav, 1978. Also, early child death information based on J Clinton, *Health Population and Nutrition in LDCS A Hand book*. Washington, Family Health Care Inc, 1979.

Table 2 : Death Rate among Age-group

Age (in months)	Percenge of Total childran 0-4	Total Deaths among 0-4	
0–6	10.8	05	86
7–12	10.6	10	
13–24	20.4	15	
25–36	19.8	11	14
37–48	19.3	8	
49–60	19.0	6	
Total	100.0	100	

Source : *op cit*.

It is estimated that 55 per cent children in the rural areas and 45 per cent in the urban areas (amounting to 99 million and 19 million, respectively) fall below the subsistence level measured in nutrition norms[1]. The infant mortality decreased from 160 per thousand in 1947 to 125 in 1978, yet this rate is till very high. The most disturbing factor is that the levels of infant mortality did not improve during the decade commencing 1970. Nearly 60 per cent of infant deaths occur within one month of birth (neo-natal mortality). A major part of this is preventable, as it is caused by the state of maternal health and of health facilities during delivery It is thus notable that 75 per cent of childern in 0 to 6 year-1 group have body weights below 75 per cent of the stardard weight of well-nourished children.

Infant Mortality Rate (IMR) is affected mainly by (i) nutrition intake, (ii) health facilities, (iii) demographic characteristics of the household, (iv) economic features of the

1. Report. Registrar Genral of India. **Survey of Infant and Child Mortality-1980.**

household, (v) literation/nutrition knowledge, (vi) hygiene and environmental sanitation, and (vii) initial endowment of health (including state of health of the mother). Empirical evidence of differentials in IMR due to different other factors (some related to the above) is given in Table 3. (Next page).

Infant mortality differentiated with respect to sex indcates the value systems and social customs influencing the parental care bestowed on infants of either sex. Whereas the differentials are favouring males in States like Himachal Pradesh (107 male, 149 female) and UP (133 male, 146 female) opposite is true in State like Tamil Nadu (130 male, 110 female). Statistical analysis of intake of nutrients by children in Tamil Nadu carried in latter sections of this report indicate that there is no significant preference in feeding attributable to sex of the child

Table 4 indicates the relative roles of aducation and water supply in rural/urban areas in possibly affecting child mortality.

Table 4 : Role of Education and Water Supply :

Child Mortality Differentials (1978)
(Child dsaths 1-5 years per 100,000 population)

Education Factor	**Rural**	**Urban**
Illiterate	294	166
Literate but below primary	62	67
Primary and above	37	24
Matriculate and above	54	41
Water supply		
With	192	96
Without	234	97

Source : Survey of Infant and Child Mortality 1979. (Preliminary Report) Registrar General of India, New Delhi.

Table 3 : Infant Mortality Differentials-1978

		Rural	Urban	Total
Infant Mortality Rates				
India	...	136	70	125
Scheduled Caste	...	159	90	
Scheduled Tribe	...	113	—	
Level of education of women				
Illiterate	...	132	81	
Literates below primary	...	105	59	
Primary and above	...	64	49	
Occupation of women				
Farmers, fishermen and related works	...	127	119	
Production, transport and related labourers, workers	...	194	121	
Work Status of Women				
Workers	...	130	98	
Non-workers	...	123	63	
Age of marriage of women				
Below 18 years	...	141	78	
18–20 years	...	112	66	
Source of drinking water				
Tap	...	103	63	
Handpump	...	105	71	
Pond/tank/river	...	105	91	
Well	...	137	93	

Table 3 (Contd.)

Presence/absence of social amenities

	With		Without	
	Rural	**Urban**	**Rural**	**Urban**
Water supply ...	108	66	134	94
Motorable road ...	110	62	139	82
Bus stand ...	105	51	138	73
Railway station ...	56	65	131	69
Primary school ...	126	65	145	71
Medical facilities ...	102	57	136	79

Source : Registrar General of India, Ministry of Home Affairs. Survey of Infant and Child Mortality, 1979-A Preliminary Report.

Although it is difficult to obtain empirical studies in respect of Tamil Nadu examining the type of issues we are interested in, it is useful to make a note of the investigative studies carried elsewhere in the country despite possibilities of conditions being dissimilar. In the Narangwal study[2] carried out in Punjab, the effect of malnutrition and mortality is estimated by comparing the mortality rates among well-nourished and malnourished children. Children whose weight fell into the malnourished range less than 3 months before death were classified as malnourished. It was likely that their weight loss was the result of the fatal illness rather than a cause; the death rate of malnourished children in the age was almost nine times that of the corresponding malnourished group. In 687 of the deaths observed, malnutrition was pressent and most of these deaths were in the age range of 4-12 months.

2. Narangwal, *Interactions of nutrition and Infection: A Prospective Field Study on Children in Selected Villages of Punjab*. Report to the ICMR by Rural Health Research Centre, (1972).

Between 1959 and 1970, the per capita income in Punjab has more than doubled. The death rate in 12-35 months group has come down to less than half the 1957-59 figure. This drop is due to improved nutrition resulting from better economic conditions. The prenatal[3] and neonatal[4] mortality being unchanged suggests that the level of obsterical and paediatric care for this age group has not gone up during this period. Nutrition of mothers has not improved as much as nutrition of their children.

Preventable Blindness

While measles may be one of the major causes of blindness in children, particularly in Africa, the problem has not attained such dramatic proportions as that of malnutrition. In its initial stage, blinding malnutrition is called xerophthalmia. The child suffers only from night blindness, but then has gradually increasing difficulty in seeing during the day as well. In the end, the corneas of the eye literally collapse : keratomalacia has by then caused the complete blindness.

The disease is an aspect of calorie/protein malnutrition, particularly associated with an absence of vitamin A during the first months of life. The precise chain of event has not yet been fully understood, particularly with regard to the final collapse of the eye. But the relationship between this type of avitaminosis and the eventual blindness cannot be doubted. Its incidence may be related to improvements achieved in the health field over the last few decades. Earlier years children who suffered from such a degree of deprivation and malnourishment probably either died in the first months of their lives, or had such low level of resistance that they subsequently

3. *Still births + Early Neonatal deaths* X1000
Live births + still births.

4. The number of deaths per 1000 live births occurring in the first 28 days of life.

succumbed to malaria, smallpox, diarrhoea, measles, etc. Since these diseases are increasingly under control, many children who previously would have died now stay alive but become blind through vitamin A deficiency which is much more difficult to remedy thad is the more obvious calorie/protein malnutrition.

As pointed out by the UNICEF[5] the increased incidence of xerophthalmia and keratomalacia should be seen as one of the typical phenomena at a given phase in a country's national development-when the country has been able to lower the child mortality, but has not yet managed to provide adequate health care and prevent the more complicated health problems. It may also be looked upon as a sign of imbalance in the approach of policy-makers and physicians: generally, and understandably, the main thrust of health services is aimed at mortality, where successes are most rewarding and immediately visible. Under the conditions of resource shorttage that prevail in most developing countries, however, a mortality-biased health system can only function at the cost of paying attention to the morbidity problem. Hence, the paradox that, within a "healtheir" society, the number of sick and handicapped people tends to increase.

Such observations are saddening indeed, since they provide scope to expect that the problem of vitamin A shortage will increase considerably before the most populated countries of the world, where this problem is most obvious, will be able to improve their health care sufficiently. Already, some of these countries are suffering from immense problems with xerophthalmia. In India, an estimated 92 million children are in the most vulnerable age group, from 1 to 5 years. Of them, at least 7.5 million have vitamin A deficiency and in at least 220,000 children, the onset of blindness is percep-

---

5. *UNICEF. Ideas Forum* Supplement No. 11, 1981.

tible. The available data suggest that, of these, 25 per cent will become totally blind. Of the others, 60 per cent will remain partially blind. Thus, it is reasonable to assume that each year in India alone, over 50,000 children suffer from complete loss of sight. In that same period, up to 130,000 children become partially blind. Of the latter, the majority will be able to see the world around them, but will not be able to function economically and socially like their non-handicapped brethern. Thus, blindress caused by malnutrition is a priority area that needs attention.

In this direction, Table 5 indicates the estimated performance indicators and targets for the Sixth Five-Year Plan (1980 85), in terms of coverage of population against prophylaxis. The percentage coverage has been considerably increased during the last seven years. However, it should be further reinforced by proper effort for creating preparedness of the community (via health education efforts) and natural improvement in the intake of vitamin due to improved food consumption habits, raise in income levels and efforts to ensure that foods with higher vitamin A are within the reach of every household.

Table 5 : Past Performance and Targets for the Sixth Plan (in million)

	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80*	Sixth plan targets totals
Prophylaxis against nutritional anaemia among							
a) Mothers	6.68	3.70	3.29	8.38	9.80	10.08	60.00
b) Children		3.52	3.05	6.85	9.03	13.43	60.00
Prophvlexis against blindness due to vitamin 'A' deficiency	3.89	4.48	7.00	10.33	13.57 (first does)	14.95 (first dose)	125.00

* Figures are provisional

Source : Sixth Five-Year Plan, p. 386.

Mental Abilities

The nutritionists' finding is that the early deprivation of necessary nutrition to children has much more severe effect on their development than deprivation at any other stage. The irreversibility of consequences due to malnutrition in children is a very important feature. This is specially important as the mental development (brain formation) up to 8 years of age is about 80 per cent and this factor is irreversible. According to the experiences reported by Williams,[6] the "young under-nourished children were compared with children whose nutrition has been superior. It was found that there was 22.6 per cent points difference in favour of the better nourished group. Every effort was made to eliminate other factors, such as differences in intelligence of parents. It was concluded that not only were the under-nourished children retarded in intellectual development because of poor nutrition but intellectual development indefinitely and presumably permanently impaired. Some of the under-nourished were tested over a period of seven years. There was no improvement".

The criticality of nutrition factor in the child age-group is further reinforced by the mental impact aspects : "infants who receive inadequate quantities of both protein foods and *sensory stimulation* in the first year of life will almost certainly show significant relations in performance of standard IQ and other tests of intelligent even when they are well-nourished for the rest of childhood (and develop almost normal in physical terms)".[7]

According to Tamil Nadu Nutrition Study, about 45 per cent of children in Tamil Nadu died before the age of 5 years and that, about 50 per cent of the pre-school children in the

---

6. Williams R. *Nutrition against Disease*. New York Pitman Publishing, 1971.
7. Selowsky M, Taylor L. The economics of malnourished children : An example of disinvestment in human capital. *Economic Development and Cultural Change October 1973, 22(1) 17-30.*

State were malnourished, as assessed during 1973-74. On humanitarian ground alone, the problem of morality and malnourishment in children assumes great urgency and importance. It is estimated that the pre-school children with nutririon related disorders account for about 23 per cent of all patients treated in government hospitals, although the pre-school children constitute only 16 per cent of the State population. Another study by the Institute of Child Health, Madras, found that nutrition was a leading or associated cause of about 42 per cent of deaths of the pre-school children covered under the survey. The various nutrition programmes in operation in Tamil Nadu reach hardly 10 per cent of the pre-school children, and even then the success was very limited due to a number of factors, some of which are: (1) feeding programmes failed to reach the targeted beneficiaries due to non-compliance in selection of eligible children; (2) substitutability in food consumption takes place at household level as a result of supplementary feeding given to children; (3) the government agencies operating on a drop-in basis rather than making continued effort on fixed set of children with due flexibility and monitoring of operations governing the supply of nutrients, both in form and quantity; and (4) absence of adequate health care components to take precautions against infectious diseases and diarrhoea.

2

Review of Policies

The existing organisational aspects relateing to evolving and implementation of various child nutrition programmes are discussed in a separate study on Coordination, Monitoring, and Evaluation. This section briefly examines a few historical dimensions in the process of evolution of some policies. The first attempt to organise service for pre-school children was the establishment of the Central Social Welfare Board in 1953 which developed a network of rural balwadies.

The Union Ministry of Education and Social Welfare has set up a Study Group in 1972 on the development of the pre-school child "to examine the question and to prepare an action for the development of the pre-school child through the mobilisation of local resources, especially in rural areas". It is ironical that although the Group noted that "medical evidence has shown that if health and nutrition are neglected in the first few years of life, the learning capacity of the child is likely to be impaired even when iis conventional intelligence is within normal range, ... it is therefore, essential to provide adequate services for the pre-school child, if the national potential of talent is to be fully utilised and developed", it was decided by the Group that the Report (of the study group) should deal with the age group 3 to 5 years only "partly because institutionalised services of any type, particularly educational, could be provided mainly for this age group".

There are at least two snags in the above approach: firstly, having recongised the irreversibility factor in child develop-

ment and the adverse effects of malnutrition in early stages of life, the adoption of age group 3 – 5 is open to question. Secondly, having admitted that there is scarcity of resources, priority should have been given to the most deserving category and not for any arbitrary category. Whereas the objective of the setting up of the Study Group was to evolve policies for pre-school child development, ironically the age group was decided upon the basis of provision of educational facilities for that group, namely, school going children.

As regards the plan and action, the Study Group recommended the following "strategies": (1) Community support and involvement, (2) employment of suitable local women in rural areas, (3) part-time employment of educated women in urban areas, (4) part-time employment of students, (5) maximum use of the existing institutions and facilities (including NSS, PHCs, etc), evolving a variety of models to suit local conditions.

The last two recommendations are considerably vague. The target fixed by the Group and described as "reasonable and feasible" was to cover 5 million children by 1981 which constituted 10 per cent of the child population in the country. The target is arbitrary. It is neither need based nor tailored to suit the budget position.

The Fourth Five-Year Plan Mid-term Appraisal[8] while dealing with nutrition programmes, stated that the following requirements be kept in view :

1. since the resources are limited, it is necessary to establish priorities with reference to needs, class, and areas

2. it is important to improve the efficiency and extend the coverage of the organisations which serve the needs of the priority age-groups, classes, and areas

---

8. *Fourth Five Year Plan Mid-term Appraisal*. *Vol. II*. New Delhi, Planning Commission, December 1971, p. 126.

3. Programmes of distribution should be supported wherever necessary by programmes of production, processing, and supply.

In dealing with production of unconventional foods supplementing targets for foods like balahar, weaning foods, groundnut, flour and soyabean products, were fixed in the plan.

The considerations advanced in the above Plan documents clearly emphasise the need for allocating resources for the priority age-group — 0–3 years — and also for evolving additional criteria for the selection of eligible beneficiaries based on the socio-economic and physiological considerations. Based on the physiological, psychological/mental development, and family planning motivation arguments, it is clear that the primary target should be pre-school children. To reach this group, it should be possible to partially achieve some nutrition intake targets by intervening in the pregnant and lactating womens' diet intakes. There is some controversy about the lack of significant correlation between increase in intake of nutrients by lactating women and breast milk formation; however, the minimum that can be expected is that such an invention can lead to improved health status of the women, which has direct and indirect positive benefits for the current and possibly future children.

3

Economic Dimensions of Malnutrition

As argued by Selowsky,[9] the economic justifications for improving children's nutrition can be classified into three types: (a) based on the notion that child nutrition is a "public good" or an "externality" to the rest of the society, that is, the rest of the society derives a consumption benefit from eliminating malnutrition; under the notion, the existence of malnutrition implies a distorted (or non-pareto-optimal allocation) of present economic resources; (b) based on the "resource saving" effect of better child nutrition; if specific social objectives to which the governments are already committed, such as mortality rates, etc, are the product of nutrition-cum-other policy manipulable causal factors, better nutrition can, at the margin, be a cheaper intervention than the other interventions in achieving those objectives; and (c) based on the concept that better infant nutrition tends to increase the future productivity of the individual — the human capital argument. Childrens' nutrition can also be treated as a "public good". Non-Pareto optimal situation can be improved nearer to Pareto-otpimal situation[10] — if we consider diseases (in relation to malnutrition) and general environment. Resource

---

9. Selowsky M. *The Economic Dimensions of Malnutrition in Young Children*. World Bank Working Paper No. 294, October 1978.

10. Pareto-optimal situation arises if there is no further improvement in welfare/gains to individuals is possible, with change in allocation, without adversely affecting one or more individuals.

saving argument justifies the intervention in child nutrition system. Malnutrition in children must be viewed as a disinvestment in human capital.

Other benefits relate to the population growth, child mortality affecting the demand for fertility, both through modification of what parents expect the child mortality to be in future which encourages hedging demand ex-ante, and through inducement of replacement demand ex-post, after a child's death. Selowsky and Taylor[11] considered the linkage between the early malnutrition and productivity via the effects of measured intelligence on earnings; Terman-Merrill Intelligence Test was used for a sample of Chilean children, which confirmed positive correlation between nutrition intake and IQ. The empirical observations suggested that a 10- per cent change in IQ is associated with 6 to 7 per cent change in earnings; the approximate rate of return on investment for improving child nutrition status was found to be nearly 20 per cent. However, it must be noted that the rate of return is bound to be very sensitive to demand and supply features of different job markets and also to geographic demarcation of job markets.

Mortality, health status, indices of physiological achievements are some of the consequences of nutrition status of a child. Since data on all these parameters are not easily forthcoming the most approximate indicator of nutrition intake is calorie consumption, considering the nutrition intake as a close approximation of nutrition status.

For analysing the socio-economic determinants of nutrition status of children, it must be noted that the mean per capita household consumption of food or nutrients is not necessarily a good indicator of nutrition status of children in-

---

11. Selowsky M, Taylor. The Economics of malnourished children - An example of disinvestment in human capital. *Economic Development and Cultural Change, October 1973, 22 (1), 1730.*

dividually—due to problems of intra-family inequitable distribution of nutrition. Since the poorer income groups have a substantially larger family size and number of children, the share of children that are malnourished tends to be larger than that of adults. It is this intra-family distribution aspect of malnutrition that gives rise to larger incidence of malnutrition in children, compared to other members of the family. Thus, at a given poverty line, whichever calorie norm is used for defining poverty for the household, the household might fulfil nutrition needs only on the average and not necessarily in case of every member of the family, and especially in the case of children in the household. It is, therefore, clear that if poverty line is to be defined on the basis of adequate intake of nutrition by children (based on standard norms of child nutrition requirement), the estimated magnitude of poverty will be considerably higher than the magnitude (about 50 per cent) estimated on the basis of average household level intake of calories.

That more than 25 per cent of children in Punjab[12] are malnourished shows that even the massive food surpluses in the State as a whole, and availability of food at aggregate level may not solve much of the problem. What is important, therefore, is the improvement in terms of equitable distribution of resources, along with attention to improved nutrition status of children in the segments of population which can afford to ensure this feature. This last aspect is very important, the possibility of improving child nutrion for the same level of household income by inculcating slight changes in food habits and consumption of non-food items.

It is rightly observed in an empirical study by Levinson[13] that "only where facilities exist which permit easy translation

12. Taylor C E, et al. Malnutrition, Infection, Growth and Development—the Narangwal Experiences. (Mimeo) 1978,

13. Levinson F J. The Economic Analysis of Determinants : Malnutrition among young Children in Rural India. (Ph.D. Thesis), Cornell University, 1972.

of improved income into such advantages as better health care and advice, improved environmental sanitation and perhaps better education, are income increments likely to make much of a difference in a child's food intake, and his health". Among the conclusions of the above study are the following, based on empirical observations in rural Ropar district in Punjab :

(i) When anthropometric measures are used to assess nutritional status in a cross-section analysis, the nutritional intake and infection are both highly significant determinants.

(ii) Calorie and iron deficiencies are more pronounced than the other nutrient deficiencies.

The interventions suggested in the above study include nutrition education, need for developing weaning foods and iron supplementations, need for supplementary feeding during 4-6 months group of children (against the present practice of about 10 months of age.)

It is useful to investigate the intra-family distribution of different nutrients in various segments of population, categorised mainly into socio-economic groups. However, it is difficult to obtain the relevant data. Information from TNNP Data Bank in respect of the composition of the household in terms of children and non-children, male and female children, and their age is used in obtaining the relationships with intake of different foods and nutrients. Some of these results are reported in the subsequent sections.

Schultz, 14th while analysing the economic framework for interpreting the determinants of mortality, assumed that mortality and morbidity are influenced by an individual's stock of "health capital" subject to subsequential seemingly random variability; when mortality is reduced, therefore, one expects the tendency for morbidity to decline. It should be possible to translate the consequences of alternate mortality and morbidity incidence levels into socio-economic consequences accruing in the short-run and in the longrun.

The difference in the incidence of malnutrition between children and adults depends mainly on two factors: (a) how strong is the (inverse) relation between the number of children per household and the per capita income of the family, and (b) how small is the size of the malnourished population, compared to the total population (of the household).

The important policy problem of defining and estimating poverty in the country cannot be divorced from the problem of ensuring "adequate" nutrition intake for children, rather than ensuring on an average for the household, simply because the economic consequences of the two situations are diffierent in a multi-period framework of macro-economic planning in which combination of market and non-market factors should be conceived to alleviate child malnutrition is a problem involving political, administrative, sociological, and technical considerations, in addition to financial constraints.

The role of the different socio-economic and environmental parameters in affecting the morbidity and nutrient intake of children needs to be empirically investigated. These explorations are reported in the next two sections.

---

14. Schultz TP. Interpretation of Relations among Mortality, Economics of the Household, and the Health Environment. Paper presented at the joint UN /WHO Meeting on Socio - Economic Determinants and Consequences of Mortality, Mexico city, June 1979.

4

Analysis of Determinants of Illness

In this section we will attempt to find out the possible relationships between illness and different factors relevant at the household level as well as environmental factors which are not necessarily within the control of the households.

The average days of illness of children is takan as one of the dependent variables (endogeneous variables), and attempts are made to explain in terms of a number of variables, such as average nutrient intake of children (in terms of calories and proteins), provision of tap water, nature of the household—working class or otherwise-caste variable (classified in terms of upper caste, backward caste and others), household expenditure, food habits (in terms of vegetarianism, vegetarian with egg consumption and non-vegetarianism), composition of family (in terms of number of children, age groups of children, number of adults, male/female children), education level of the head of the household, and rural/urban location of the household. The above set of explanatory variables which are assumed to have some bearing on the average days of illness of children are attempted in various combinations. Almost all these relationships led to either statistically insignificant co-efficients corresponding to the explanatory variables or the explanatory power of the relationship so limited to 3 per cent variation in the behaviour of the dependent variable. The above set of explanatory variables in different combinations (with appropriate change in respect of intake of children—now transformed to individual intake rather than average intake) were also used in explaining the number of days of illness of a given child (as

opposed to average days of illness of children attempted in the earlier case). In this latter exercise, the quality of results is generally significantly better than that of the previous set of the empirical relationships, although the statistical significance of some of the co-efficients corresponding to explanatory variables continued to be low in some cases and the overall explanatory variables power is also low.

The data-base for the empirical exercise is the information stored on magnetic tapes with the TNNP Data Bank at the IIT Madras Computer Centre. The choice of the explanatory variables as well as dependent variables is obviously governed by the classification and availability of information in the Data Bank. The most important assumption made in the assessment of the magnitude of dependent variables (number of days of illness) is that any disease could be equivalent to any other disease, and our concern is only with the number of days of illness as reported by the household, irrespective of the horizon of the diseases. Thus, for example, a continued illness of about 30 days due to, say, typhoid or jaundice, is attempted to be explained in terms of the same set of explanatory variables as in the case of, say, three repetitions of the same infection (like diarrhorea, cold, and cough[15]) with a duration of about ten days for each occurrence. Evidently, we cannot explain much of the variations in the number of days of illness in terms of a relatively fixed set of variables applied to all diseases. However, in the empirical exercise, a mix of all categories of diseases is made use of in terms of the total number of days of illness. Also, a serious lacuna in the attempted explanation of the number of days of illness is the waiver of the existence, type and quality of medical facilities as possible explanatory variables governing the behaviour of the dependent variables. This last set of variables on medical front could not be made use of due to problems in

15. Whether some of the households report these as diseases is another issue.

indexing these, and paucity of relevant data for this purpose. Since this set of variables can be expected to constitute an important component in explaining the behaviour of number of days of illness of children, the formulations attempting an estimation of empirical relationships using the various explanatory variables listed earlier need not be expected to provide the desired statistcal properties especially in terms of explanatory power. In general, the following implicit relations can be expressed:

Nutrition status $N_1 = f_1$ (nutrition intake, infection, environment)

Nutrition intake $N_2 = f_2$ (economic status, family size, caste, mother's education, state of health, food prices)

Infection/illness $N_3 = f_3$ (economic status, family size, mother's education, nutrition intake, health care facilities available, hygiene and preventive medicine, quality of water and environment)

Select few results which are considered relatively better among the total set of relationships empirically estimated are discussed in the subsequent paras. The following notation is used for the empirical estimation of differenr relationships:

W_3 = Average days of illnes of children
W_4 = Days of illness of child
Z_4 = Per capita consumption of calorie at household level
Z_6 = Per capita food expenditure
Z_7 = Education code G to K
Z_8 = Education code L to T
Z_9 = I if urban household and O if rural household
Z_{14} = 1 if tap water is available and O otherwise

Z_{15} = Per capita expenditure between Rs. 13 and 21 p. m.*
Z_{16} = Per capita expenditure between Rs. 21 and 34 p. m.*
Z_{17} = Per capita expenditure between Rs. 34 and 75 p. m.*
Z_{18} = Per capita expenditure above Rs. 75 p. m.*
Z_{19} = Per capita expenditure below Rs. 21 p. m.*
Z_{20} = Consumption of protein by child
Z_{21} = Consumption of calorie by child
Z_{26} = Average protein consumption of children
Z_{27} = Average calorie consumption of children
Z_{30} = 1 if child age is between 0 - 2 years, and 0 otherwise
Z_{31} = 1 if child age is between 2-5 years, and 0 otherwise
X_{10} = 1 if upper caste household and 0 otherwise
X_{11} = 1 if backward caste and 0 otherwise
X_{12} = 1 if vegetarian household consuming eggs and 0 otherwise
X_{13} = 1 if non-vegetarian household and 0 otherwise
X_{15} = Per capita total expenditure at the household level
X_{18} = 1 if working class household and 0 otherwise
T_1 = Number of female children in family
T_2 = Average (in months) age of children in family
T_{10} = 1 if male child and 0 otherwise

The following 15 specifications were rejected, where the dependent variables used were W_3 (average days of illness of children) and W_4 (days of illness of child).

1. $W_3 = f(Z_7, Z_8, Z_9, X_{10}, X_{11}, Z_{14}, Z_{15}, Z_{16}, Z_{17}, Z_{18})$.
2. $W_3 = f(Z_7, Z_8, Z_9, X_{10}, X_{11}, Z_{12}, Z_{13},)$
3. $W_3 = f(Z_7, Z_8, Z_9, X_{10}, X_{11}, X_{12}, X_{13}, Z_{14}, Z_{15}\ Z_{16}, Z_{17}, Z_{18})$
4. $W_3 = f(Z_7, Z_8, Z_9, X_{10}, X_{11}, X_{12}, X_{13}, Z_{14}, Z_{15})$
5. $W_3 = f(X_{15}, Z_7, Z_3, Z_9\ X_{10}, X_{11}, X_{12}, X_{13}, Z_{14})$
6. $W_3 = f(X_{15}, Z_7, Z_8, Z_9, X_{10}, X_{11}, Z_{14})$
7. $W_3 = f(X_{15}, X_{12}, X_{13}, Z_{14})$

---

* These variables Z_{15} to Z_{19} assume value 1 if the characteristic stated on the rhs is valid and, value 0 otherwise, the expenditure Rs. at 1970-71 prices.

8. $W_3 = f(X_{15}, Z_9, X_{10}, X_{11},)$
9. $W_3 = f(X_{15}, Z_7, Z_8, X_{10}, X_{11}, Z_{14})$
10. $W_3 = f(X_{15}, Z_7, Z_8, Z_{14})$
11. $W_4 = f(Z_{20}, Z_{21}, Z_{14})$
12. $W_4 = f(Z_{20}, Z_{21})$
13. $W_4 = f(Z_1, Z_{14})$
14. $W_4 = f(Z_{11}, Z_{14})$
15. $W_4 = f(Z_7, Z_8, X_{10}, X_{11}, X_{12}, X_{\cdot 3}, Z_{14}, Z_{15}, Z_{16}, Z_{17}, Z_{18})$

All these models have R^2 around .03 and insignificant t-ratios. As the standard errors of the regression co-efficients of the caste variables are running into lakhs with the regression co-efficients being very low, the t-ratios for these variables are almost zero. Regression co-efficient of Z_{19} is zero in both the models, it appeared. Z_{17}, Z_{18}, Z_{14}, Z_7, Z_8, X_{12}, in case of W_3 and Z_{21}, Z_{20}, Z_{17}, in case of W_4 have good t-ratios. Not a si gle variable in any of these models has significant simple correlation with the depedent variables either in the positive or negative directions. The absolute value of all these simple correlation co-efficients is below 0.1. The variables X_{10}, X_{12}, X_{13}, Z_{14}, Z_{15}, Z_{16}, are negatively correlated with the dependent variables.

Also, the following are the models regressed upon W_3 (average days of illness of children) and W_4 (days of illness of child).

1. $W_3 = F(X_{15}, Z_7, Z_8, Z_{14})$
2. $W_4 = F(Z_7, Z_8, Z_{14}, Z_{21},)$
3. $W_4 = F(Z_7, Z_{14}, Z_{21})$
4. $W_4 = F(Z_{14}, Z_{20}, Z_{21}, Z_{30}, Z_{31})$
5. $W_4 = F(Z_{20}, Z_{21}, Z_{30}, Z_{31})$
6. $W_4 = F(Z_7, Z_8, Z_{14}, Z_{20}, Z_{21}, Z_{31})$
7. $W_4 = F(Z_7, Z_8, Z_{14}; Z_{21}, Z_{30}, Z_{31})$
8. $W_4 = F(Z_7, Z_8, Z_{21}, Z_{30}, Z_{31}, Z_4)$
9 $W_4 = F(Z_{14}, Z_{20}, Z_{30}, Z_{31})$
10. $W_4 = F(Z_{20}, Z_{30}, Z_{31})$
11. $W_4 = F(Z_{21}, Z_{30}, Z_{31})$

There is only one model accepted with W_3 as dependent variable. The R^2 ranges from 0.02 to 0.03. Child age between O and 2 years is found to have best t—ratios throughout. The variable Z_4 has a near zero co-efficient with t-ratios of 1.08. In models 4 and 5, Z_{21} has t—ratios between 0.5 and above 2 in rest of the models. None of the simple correlation co-efficients are greater than O.I. Z_{14} and Z_4 have negative correlations with the dependent variables. Days of illness is more influenced by the factors child age between O and 2 years, education, and tap water.

It is of interest to examine the following two estimated relationships:

(a) $$W_4 = -0.29 + \underset{(4.13)}{0.017\,Z_{20}} + \underset{(2.37)}{0.53\,Z_{20}} + \underset{(1.69)}{0.31\,Z_{31}}$$

$$R^2 = 0.02$$

(b) $$W_4 = -0.28 + \underset{(4.08)}{0.0004\,Z_{21}} + \underset{(2.38)}{0.537\,Z_{30}} + \underset{(1.73)}{0.32\,Z_{31}}$$

$$R^2 = 0.02$$

Provision of tap water as additional explanatory variable with reference to the specification in (a) did not improve R^2 as the co-efficient corresponding to this variable was insignificant. From the above relations the positive linkage between the number of days of illness and the break-up of age-group of children seems meaningful since the disease proneness of children in the age-group 0—2 years(represented by higher magnitude of co-efficient corresponding to Z_{30}) is greater than in case of 2–5 years age–group, However, the statistically significant positive linkage of Z_{20} and Z_{21} with W_4 is difficult to explain, unless these explanatory variables eventually bring with them problems like indigestion/diarrhoea etc; alternatively, another possibility is that an increase in protein/calorie uncomplemented by other nutrients like calcium, iron, and vitamin A may not reduce or favourably affect the prospect of illness of children. Also, the diet mix from which calories/proteins are derived is as important as the calorie/protein content.

Another set of two empirical relations given below depict the relative roles of education, protein/calorie intake and provision of protected water.

$$\text{(c)}\quad W_4 = -0.15 + \underset{(1.8)}{0.3\,Z_7} + \underset{(1.6)}{0.3\,Z_8} - \underset{(1.7)}{041\,Z_{14}} + \underset{(2.7)}{0.0003\,Z_{21}},\qquad R^2 = 0.02$$

$$\text{(d)}\quad W_4 = -0.17 + \underset{(1.7)}{0.3\,Z_7} + \underset{(1.6)}{0.3\,Z_8} - \underset{(1.7)}{0.41\,Z_{14}} + \underset{(2.8)}{0.011\,Z_{20}},\qquad R^2 = 0.02$$

From the above estimated relations although initially it may be surprising that education variables Z_7 and Z_8 have somewhat significant positive relation with W_4 as opposed to the popular expectation of the opposite effect, the possible explanation could be that the recognition of illness and its symptoms is more pronounced in the case of relatively educated nouseholds than in the others. Thus, certain minor diseases may not be reported at all by the relatively uneducated households. In effect, we are not able to come to a quantitative assessment of the role of education level of the household as explanatory variable in analysing W_4.

The only estimated relation marginally explaining the behaviour of W_3 which has some relative statistical validity is:

$$W_3 = -0.02 + \underset{(1.21)}{0.002\,X_{15}} + \underset{(2.8)}{0.307\,Z_7}$$

$$+ \underset{(2.6)}{0.33\,Z_8} - \underset{(0.39)}{0.47\,Z_{14}},\quad R^2 = 0.03$$

The fact that per capita expenditure is also not a significant determinant of W_3 shows that the phenomenon of illness cannot be adequately taken care through income parameter alone but possibly requires provision of improved medical facilities and child care. The possible positive role of health and nutrition education, and preventive medicine to reduce the prevalence of illness also becomes more evident.

All these measures need to be provided possibly as public goods at the community level and steps need to be taken to ensure that there is enough realisation at the household level.

The only parameter which has consistently (in all the model specifications) maintained a negative coefficient when explaining the behaviour of W_4 is the provision of tap water. However, when this variable is used in explaining W_3 as in the case discussed above, its coefficient (though negative) was insignificant. It may be concluded that there is a strong negative effect of protected water supply on children's proneness to diseases in general, for any given income level and intake of nutrients.

The analysis carried out in this section generally leads to the conclusion that environmental parameters like improved hygiene, preventive medicine, nutrition and health education, improved medical facilities, protected water supply, and improved diet composition of baby foods are likely to be the more important factors in reducing the prevalence of illness in children than merely factors like income/expenditure and intake of calories/protein.

In the analysis of mortality, it was observed in Smucker's[16] study on the correlations of infant and child mortality (conducted in Kanpur, UP), the date provided no evidence to link the nutritional or socio-economic variables to mortality for neonatal period; for the post-natal period the results indicated that socio-economic variables have measurable impacts upon mortality but that the level of calories or quality of protein in the diet does not.

Since changes in mortality are closely related to changes in morbidity/ type and degree of illness, the results for Tamil Nadu are not possibly an exception. However, to the extent

16. Smucker C M. *Socio-Economic and Demographic Correlates of Infant and Child Mortality in India*. University of Michigan, Ann Arbor, Michigan, 1956, (Ph. D. thesis).

that the intake of nutrients is an important indicator of nutrient status, it is useful to investigate the determinants of intake of nutrients by children. The next section is addressed to this aspect.

5

Analysis of Determinants of Intake of Nutrients

It is of interest to examine the relationship between the nutrient intake of each child, and the various other socio-economic characteristics of the family to which the child belongs in addition to environmental parameters. The idea was to identify certain variables affecting nutrient intake significantly some of which might be controlled through appropriate intervention programmes. The dependent variables used were:

Z_{20} : Consumption of protein by the child

Z_{21} : Consumption of calorie by the child

It may be noted that some of the explanatory variables are specific to each child whereas the rest are not so; they are specific to the family to which the child belongs. This implies that, for example, educational background of the head of the family affects all children in the family in the same manner.

The results are summarised in the following paras. It may be noted that R^2 value is around 0.2 in all the cases. However, some of the co-efficients are significantly different from zero and we try to interpret them.

The variables X_{18} and T_{10} are statistically insignificant in all the cases. Interpretation would be that a child from a working class family consumes the same amount of nutrient which a child from a non-working family consumes, provided all the other factors remain the same. Insignificant co-efficient of the variable T_{10} indicates no difference in children's

on the ground of sex only, it belies the widespread idea that male children are more carefully looked after in our country. However, the effect on calorie intake is relatively of higher significance than on protein intake.

It is logical to expect that as income or total consumption expenditure goes up, children are fed more and more (ofcoures, up to a certain limit). The positive and significant co-efficients of X_{15} and X_{16} do precisely point out this fact only. To take a specific illustration if the total consumer expedditure goes up by a rupee, the increase in the consumption of protein and calorie of a child in that family is the order of 0.09 and 2.67 units respectively.

The co-efficients of Z_7 and Z_8 are positive, but only the second one is significant. Recalling that these two are used as dummy variables, it implies that education has a positive influence only if the head of the family is educated beyond code K. Z_{30} and Z_{31} have significant but negative co-efficients. The fact to be noted here is that the co-efficient of Z_{30}, for example, indicates the additional consumption of nutrient for a child in the age group 0-2 years with respect to a child in the age group 5-15 years. The co-efficients in equation 1 indicates that child in the age group 0- 2 years and 2-5 year, respectively, consumes 21 and 9 units less protein than a child in the age group 5–15 years. This is generally expected.

Out of 20 statistical models (four of which described above) the following four are rejected on the basis of R^2 being low:

1. $$\begin{aligned} Z_{20} = 25.03 &+ \underset{(1.04)}{1.54\, Z_7} + \underset{(2.88)}{4.67\, Z_8} - \underset{(12.3)}{21.47\, Z_{30}} \\ &- \underset{(6.45)}{9.45\, Z_{31}} + \underset{(3.85)}{0.09\, X_{15}} + \underset{0.35)}{0.51\, X_{18}} \\ &- \underset{(0.52)}{0.68\, T_{10}},\ R^2 = 0.198 \end{aligned}$$

2. $Z21 = 964.69 + 35.23\, Z_7 + 189.57\, Z_8$
$(0.64) \quad (3.16)$
$- 809\ 1\, Z_{30} - 370.7\, Z_{31}$
$(12.51) \quad (6.83)$
$+ 2.67\, X_{15} - 22.39\, X_{18} - 36.85\, T_{10}$
$(3.02) \quad (0.42) \quad (0.76)$
$R^2 = 0.202$

3. $Z_{20} = 26 + 0.08\, Z_6 + 1.76\, Z_7 + 5.61\, Z_3$
$(2.72) \quad (1.19) \quad (3.53)$
$- 21.4\, Z_{30} - 9.5\, Z_{31} + 0.16\, X_{18} - 0.58\, T_{10}.$
$(12\ 21) \quad (6.5) \quad (0.11) \quad (0.44)$
$R^2 = 0\ 191$

4. $Z_{21} = 989.22 + 2.44\, Z_6 + 40.12\, Z_7 + 214.99\, Z_8$
$(2.33) \quad (0.73) \quad (3.60)$
$- 807.1\, Z_{30} - 371.95\, Z_{31} - 33.16\, Z_{18} - 34.42\, T_{10},$
$(12.46) \quad (6.84) \quad (0.62) \quad (0.71)$
$R^2 = 0.198$

(around 0.03) to 0.04). These are :

1. $Z_{20} = f\,(Z_7, Z_8, X_{15}, X_{18})$
2. $Z_{21} = f\,(Z_7, Z_8, X_{15}, X_{18})$
3. $Z_{20} = f\,(Z_7, Z_8, Z_6, X_{18})$
4. $Z_{21} = f\,(Z_7, Z_8, Z_6, X_{18})$

The remaining 12 formulations (out of 20) are given below :

i) $Z26 = f_1\,(Z_7; Z_8, X_{15}, T1, T_2)$
ii) $Z_{27} = f_2$ (as above)
iii) $Z26 = f_3\,(Z_7, Z_8, X_{15}, T_1, T2)$
iv) $Z27 = f_4$ (as above)
v) $Z26 = f_5\,(Z_6, Z_7, Z_8, T1, T2)$

vi) $Z_{27} = f_6$ (as above)
vii) $Z_{26} = f_7 (Z_6, Z_7, Z_8, X_{18}, T_1, T_2)$
viii) $Z_{27} = f_3$ (as above)
ix) $Z_{26} = f_9 (Z_7, Z_8, X_{15}, X_{18}, T_2)$
x) $Z_{27} = f^{10}$ (as above)
xi) $Z_{26} = f_{11} (Z_6, Z_7, Z_8, X_{18}, T_2)$
xii) $Z_{17} = f_{27}$ (as above)

When the average protein/calorie intake by children in each household is treated as dependent variable, the statistical explanatory power of various determinants attempted was significantly less (of the order of $R^2 = 0.1$) than that of the same determinants when used with the dependent variables protein/calorie intake by individual children (with R^2 around 0.2). This is not a surprising observation, as in the former case certain behavioural relations get averaged out leading to less direct relationship among the parameters.

These models attempted to explain the average intake of protein and calorie by children led to the following observations :

The statistical explanatory power of the relationships given above were all around 10 per cent. However, certain qualitative observations may be useful. The average age of children (given in months) is positively co-related with the average intake of protein and calorie by children, and also the co-efficient in the regression equation is statistically very significant. The explanatory variable indicating the occupation classified in terms of working class and others did not bear any significance in any of the relationships. However, whenever the statistical significance of the co-efficient corresponding to this variable is relatively better than other specifications, it yielded a negative co-efficient indicating that the other working class feed less to children compared to others. This seems to be valid in spite of the fact that the total expenditure of the household is positively co-related with the average intake of calorie and nutrients of children.

In all the cases, this variable relating to total expenditure is also statistically significant. This obviously indicate

for the same level of income if we compare the working class household and a non-working class household, the children in the first category are relatively worse off, compared to those in the other category, possibly due to higher nutrition needs of other members of the family in order to sustain the given level of income. The total number of female children in the family did bear a positive and statistically significant co-efficient, contrary to popular hypothesis that male children are fed better compared to females. The behaviour of the regression models using the above explanatory variable is further ratified when the dummy variable T_{10} is used as an explanatory variable along with other variables in the models described in the previous sub-section. This indicates a possibility that on the agregate level when all the expenditure and socio- economic groups are included as is the case in the present emprical analysis, the popular hypothesis may not be valid due to possibilities to the contrary in terms of greater care for female children in households belonging to higher income groups.[17]

As expected, the per capita food expenditure when used as an explanatory variable led to a positive co-relation with the dependent variables and also the co-efficient of this variable is statistically significant in all the specifications of regression models. Table 6 provides a statistical insight into the average dietary intake of pre-school children in terms of calorie, protein, vitamin A, iron, and fat. Also, deficiency diseases attributable to insufficient intake of vitamin A and vitamin B as well as Protein/Calorie Malnutrition (PCM) and Anaemia in case of children in different age groups up to 6 years age are given in Table 7. Although, we would have

---

17. This claim is partially supported by the Levinson Study in Punjab where he observed that "the most serious male-female differentials in the explanatory variables occur at the lower end of the income 'spectrum'".

liked a rigorous empirical analysis tracing back the determinants of these diseases, the limitations of data deterred us from making that attempt. It would be useful to analyse the deficiency diseases in terms of measures of nutrient intake as well as in terms of environmental factors.

Table 6 : Average Dietary Intake of Pre-school Children

Age group	Sex	Number of diet surveys	Average calorie intake (K. cal)	Average protein intake (gr)	Average Vitamin A intake (I U)	Average iron intake (mg)	Average fat intake (grams)
0 - 1 years	Boys	430	419	3.3	244	3.5	21.2
	Girls	542	417	8.1	236	4.5	21.6
1 - 2 years	Boys	567	611 (1,200)	15.5 (17)	232 (250)	5.0 (15.20)	15.7
	Girls	561	567 (1,200)	13.6 (17)	183 (250)	4.5 (15.20)	15.5
2 - 3 years	Boys	528	791 (1,200)	21.00 (18)	98 (250)	12.0 (15.20)	8.6
	Girls	573	798 (1,200)	20.1 (18)	102 (250)	11.7 (15.0)	7.2
3 - 4 years	Boys	539	990 (1,200)	23.7 (20)	117 (250)	14.3 (15.20)	9.0
	Girls	547	940 (1,200)	23.6 (20)	120 (250)	13.9 (15.20)	8.7
4 - 5 years	Boys	555	1,083 (1,500)	26.3 (22.0)	177 (300)	16.4 (15.20)	8.7
	Girls	531	1,037 (1,500)	25.6 (22.0)	146 (300)	16.2 (15.20)	
5 - 6 years	Boys	335	1,230 (1,500)	29.2 (22.0)	136 (300)	17.6 (15.20)	10.1
	Girls	375	1,222 (1,500)	28.9 (22.0)	173 (300)	17.3 (15.20)	9.3
Ante-natal mothers		417	1,856 (3,300)	45.1 (55.0)	279 (750)	23.5 (40)	14.9
Post-natal mothers		924	1,959 (3,700)	47.5 (65)	175 (1,150)	32.3 (30)	15.6

Figures in brackets are the nutrient requirements of the corresponding age groups. The data are based on surveys carried out at different points of time in different years during 1972 to 1979.

Source : *Integrated Nutrition Improvement Project - Tamil Nadu.* Social Welfare Department, Government of Tamil Nadu.

Table 7 : **Deficiency Diseases**

Age group	Sex	Vitamin A		Vitamin B		P. C. M.		Anaemia	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1	2	3	4	5	6	7	8	9	10
0 - 1 year	Boys	19	4.4	12	2.8	16	3.7	15	3.5
	Girls	19	3.5	25	4.6	19	3.5	23	4.2
1 - 2 years	Boys	93	16.3	52	9.1	53	9.3	50	8.8
	Girls	89	15.8	55	9.8	44	7·8	61	10.8
2 - 3 years	Boys	125	23.3	69	12.8	41	7.6	60	11.2
	Girls	128	22.1	72	12.4	51	8.8	53	9.1
3 - 4 years	Boys	200	33.9	101	17.1	22	3.7	63	10.7
	Girls	140	25.3	74	13.4	34	6.1	65	11.7
4 - 5 years	Boys	232	41.4	107	19.1	10	1.8	83	14.8
	Girls	158	29.5	96	17.9	20	3.7	70	13.1
5 - 6 years	Boys	167	42.6	80	20.4	9	2.3	51	13.0
	Girls	136	35.9	69	18.20	15	4.0	56	14.8
Ante-natal mothers		29	6.7	81	18.8	—	—	239	55.6
Post-natal mothers		49	5.3	146	15.7	—	—	530	57.0

Source : *Integrated Nutrition Improvement Project - Tamil Nadu.* Social Welfare Department, Tamil Nadu.

6

Summary

(a) Based on a number of considerations, economic and non-economic, it is clear that the top-most priority in attending to nutrition problems should be accorded to pre-school children. It is doubtful whether some of the policies aiming at the development of school-going children, as compared to the above vulnerable age group have any greater advantages, except the convenience in administering the programmes in the latter case. However, when we recognise the need for breast feeding of children uptil about one year, it is evident that the feasibility of implementing nutrition programmes aimed at the development of children in the age group 0- 1 year is considerably greater if we operate via proper feeding of lactating mothers. The age group 1- 4 years could however be a problem for implementation of feeding programmes in the absence of institutional arrangements for distribution of different supplementary foods. This problem could be overcome possibly through market mechanism by production and supply of low cost weaning foods.

(b) The major cause of illness among children seems to be the lack of protected water supply. Urgent priority needs to be given to problems ensuring proper assimilation of given intake of nutrients by children. Preventive medicine, improved hygeine and sanitation also come under this category. Further studies dealing with disease specific determinants of illness may be more useful if the necessary data are available.

(c) The education parameter classified into categories, namely, up to 4th standard (including illiteracy), 5th to 9th

standard, and 10th standard and above did not help in identifying the relative impact of varying levels of education on the illness pattern. It would have been a more useful exercise if education could be treated as a continuous parameter and the pattern of illness (even if average illness) could be explained in terms of this parameter among others. The existing data available with TNNP Data Bank did not lend itself for adoption of this approach.

(d) Even though protected water supply is identified as the major cause of illness, this explanatory variable could not be treated as a continuous parameter. In order to find out the linkage between different levels and types of illness and different patterns of availabity of protected water supply the consumption by childern at school/ at home/protected water supply scheme in conjunction with appropriate hygeine and sanitary conditions including drainage facilities should be examined. Based on such an analysis, an optimal trade-off between provision of protected water and related environment (including drainage) versus some tolerable limit of certain types of illness could be analysed for investment decisions leading to provision of the necessary facilities.

(e) The calorie/protein content of diet consumed by children is a poor indicator of nutrition status of children and much less the health status of children. This is mainly because the food basket composition for children is as important as the actual nutrition content of the basket. Again, the role of and need for evolving weaning foods becomes apparent.

(f) The officially classified categorisation of castes in Tamil Nadu into backward and other groups did not help us to identify these parameters as relevant in determining the health status of children. Similarly, food habits in terms of vegetarianism and non-vegetarianism also did not provide any significant explanation to the illness phenomenon.

(g) The positive correlation between education and proneness to illness may appear surprising, but the way the education parameter has been coded into the three groups mentioned earlier and considering the fact that relatively educated people may report less significant diseases as diseases compared to others, it may not be an odd observation.

(h) For the same income group, the source of earning does make a difference in determing the intake of nutrients by children; the children belonging to the working class families are worse-off, compared to those in other occupations for the same level of income, possibly because of the intra-family distribution of food in favour of the head of the household. The felt-needs of the family unit in favour of the head of the household may be valid in many categories, but the relatively higher need in view of the occupation of the head of the household seems to adversely affect the residual available nutrition for the children.

(i) The popular belief that male children are preferred to female children does not seem to have validity at least in terms of consumption of nutrients. A disaggregated analysis for different socio-economic groups might, however, provide further insight into this problem.

Appendix—4

Consequence of material malnutrition

The birth weight of an offspring has been found to correlate with maternal dietary intakes of calories and protein (Ankegowda *et al*[18] and iron (Ghosh *et al*[19]. Maternal malnutrition has also been reported to retard foetal growth as assessed by anthropometric measurements. (Lakshminarayana *et al*)[20] lowered bone density and cervical thickness (Krishnamachari and Iyengar)[21], and anatomic growth retardations in the infant. Pregnancy wastage as seen by the incidence of abortions and miscarriages are high in women with low calorie and protein intakes. Still birth rates in the developing countries are higher than in the affluent countries mainly due to maternal malnutrition affecting the viability of the foetus. The viability of the offspring is also reflected in neonatal death which comprise 51 per cent of the infant deaths in India (vital statistics 1971)[22]. The infants born of malnourished mothers have low nutrient stores of vitamins A, C and iron[23] and lowered immunity to infections. The infant is

---

18. Ankegowda K, Sumitra Devi K S. Indian Journal of Pediatrics 1976, 13 (4) p. 283.
19. Ghosh, Shanti, Mooja V, Mittal S K, Verma R. K. Indian Journal of Pediatrics 1977,14 (2).
20. Lakshminarayana Prema, Nagaswamy S, Raju V B. Indian Journal of Pediatrics, 1974,11 (2) 803.
21. Krishnamachari K A V R, Leela Iyengar *American General of Clinical Nutrition* 1975 28, 482.
22. Vital Statistics of India 1971. New Delhi, Off. Registrar General of India, Ministry of Home Affairs, Government of India.
23. Venkatachalam P S, Bull. *WHO* 1962 26, 193. Report close correlations between protein and vitamin A levels in blood in both mother and infant. Maternal hypoalbununeria and serum vitamin A levels are reflected in

dependent on maternal supply for its entire supply of gamma globulins which confers immunity (passive immunity) to the infant for the first six months of birth. Infants born of severely malnourished mothers lack this immunity and are therefore greatly susceptible to infections in the first few months of life which cause a large percentage of neonatal and infant deaths.

A child born to a malnourished mother may catch up to a great extent in physical growth with an adequate diet but the impairment of the central nervous system may be irreversible and leave the individual permanently damaged in respect of intellectual functioning. The eighth to twelfth week following conceptions when foetal cerebral contex begins to form and the period of the brain growth spurt (last three months of pre-natal life to 18-24 months post-natal life) are the critical times when nutritional deficiency can spell mental inadequacy. The size, weight, structure, call number[24] and chemical composition of the brain[25] have been reported to be affected due to maternal malnutrition. Maternal deficiency has also been reported to affect neurometer development (Simonson *et al*)[26] which result in persisting behavioural abnormalities in later life.

Malnutrition during pregnancy also results in the lowered nutrient stores in the mother for successful lactation and therefore has an indirect effect on the nutition of the new-

24. Winick M, Rosso P. Pediatrics Res. 1969, 3, 181, reported that cell deficit created during the intra uterine life of infants who suffered prenatal malnutrition, persists and is irreversible.

25. Zamenhof S E, Von Mathews Margolis F L, Science 1968 160, 322 found the ptotein and DNA content of the brain to be reduced in offspring of malnourished mothers (protein deficient) and adequate diet after births. did not correct the deficit and the impairment in physiological performance

26. Simonson W, Sherwin, Anilene R W, I K Y W W Y Chow B F, Journal of

born infant. Thus, the parental nutritional status reflects on the succeeding generation with an ultimate failure of human beings to achieve their full genetic potential. As it is difficult to feed all children in underdeveloped countries adequately throughout their childhood, one should consider the most important periods of development from the point of view of ultimate achievement of full physical and mental potential. There seems little doubt that priority on this basis will have to be given to the last part of pregnancy and the first several months of life.

Consequences of Malnutrition in Transitional Stage (2nd Stage)

The immediate effects of widespread malnutrition is evident in the toddler mortality rate of the country. In India, while children in the age group-0-5 years constitute about 16.5 per cent of the total population, deaths within this age group account for 40 per cent of the total deaths in the country (Nutrition Atlas) [27] Malnutrition is a major factor under lying the toddler mortality rate of 11.3 per cent which has remained almost stationery over the last few years, although infant mortality has shown a decline.

Longitudinal studies conducted on children who had earlier been successfully treated for Kwashiorkor indicate that the heights and weights of these children generally fell well below the community norms. [28] Malnourished children are reported to be shorter in stature in pre-school years as well as in adolescence compared to those who are brought up under better dietary care. This pattern of height and weight may continue into the 2nd, 3rd or succeeding generation due to a persistent pattern of undernutrition throughout this period. Hence many adults belonging to the lower socio-economic classes show smaller heights and lower weights, compared to people

27. Gopalan C, Vijayaraghavan K. Nutrition Atlas of India 1971.

28. Op. cit. NIN, ICMR, India, 1971.

in the same area, but belonging to the upper socio-economic classes. Growth retardation leads to skeletal immaturity as well.

The accumulated evidence leads to the general conclusion that malnutrition in the first years of life, if severe enough to retard physical growth and to necessitate admission to hospital, may cause mental impairment also. If the deprivation is severve and prolonged, the retardation of brain development and functions so produced may be so serve that it cannot be completely cured by nutritional rehabilitation. On the basis of several studies, it has been concluded that mental retardation could occur at mild to moderate degrees of PCM associated with stunted growth and is not limited to extremely severe to cases, like Kwashiorkor and Marasmus. It is also reported in studies presented in some journals that children during the stage of active malnutrition have very low IQ, during a long-term follow-up of 5-10 years it was revealed that IQ. remained significantly low, even though there was marked improvement in the behaviour during recovery. Srikantia and Shastri (1971). however, on a longitudinal study of children who suffered from Kwashiorker, reported that although at the first time point of study, the experimental children were low in neuro-integratie competence, after five years, their pe.formce was identical to the controls. In the same children during the recovery period, the increments in height and weight were similar to the control children, but the initial differences in height and weight persisted.

If malnutrition exists, the interaction of other improverishing factors, causes behavioural deficits and low intelligence scores to persist. The degree to which recovery occurs after a period of rehabilitation is dependent not only on a good nutritional intake but also on a stimulating environment. The latent potentialities of man have a better chance of emerging when the maternal child relationship and home environment is good and social environment is diverse and stimulating in addition to a nourishing diet.

3

Integrated Nutrition Planning : A Synthesis

1

Introduction

The objective of this part is to synthesise the various aspects of studies on nutrition planning that have been carried out under different phases by ASCI, Hyderabad, during the last few years under the Tamil Nadu Nutrition Project. In this process it is hoped to provide an overview of the approaches for nutrition planning as well as the nutrition situation in Tamil Nadu. In the latter part, suggestions for improving the situation and for bridging the nutrition gaps were given. Also the possibilities of operationalising some of the approaches and suggestions are discussed.

At the outset, it is useful to review the fundamental problem of specification of nutrition requirements, to dispel the controversies that still prevail on this aspect. This is briefly carried out in the next subsection. Subsequently, the framework for nutrition intervention strategies was examined, followed by a discussion of the formal analytical approaches to integrated nutrition planning. Planning is not simply an application of appropriate techniques in formulating the activities and resource allocation; it should be reviewed periodically in conjunction with the operational and institutional aspects, including monitoring, review, evaluation, and co-ordination, with a view to refining the approaches to plan formulation and implementation. Viewed in this perspective, a judicious blend of analytical aids for effective planning and the institutional mechanism for efficient implementation of the schemes will go a long way in nutrition problem-solving exercises.

Thus, Part I of this report tries to take precisely this path of analysis. In this, it is hoped that this approach may be adoped in almost all the States. Detailed investigations are carried out in the case of Tamil Nadu. The second part of the report tries rappoachement between the demand and supply to enable gauging the likely gaps in food and nutrition in Tamil Nadu, so that rational policies for mitigating malnutrition could be evolved. Accordingly, projected normative requirement (giving the age, sex, size, distribution of population in Tamil Nadu) for the next few years, and based on the revised nutrition norms prescribed by the ICMR as well as on comparisons of the trends in net availability of different major food items, production of food items are projected. In order to assess the food gaps, the normative nutrition requirements (based on the ICMR norms) have been transformed into food requirements giving due weightage to food habits, and the standard diet patterns. once the magnitude of these gaps is assessed, possible interventions to minimise these nutrition gaps are suggested.

Fundamental Features

There are various established norms for nutrition requirements for different categories of population classified according to age-sex-occupation-height-weight-climate, etc. The international norms evolved by the Harvard expert group and the norms endorsed by WHO/FAO were considered and adopted by the ICMR for the Indian population. The norms were revised again in 1981 by the ICMR, under which higher intakes of calorie and other nutrients for the child age groups, and lower intakes for adults were suggested.

Dandekar and Rath, based on the average calorie intake of a household, had evolved a poverty norm. This concept has been questioned by Sukhatme. One of the alternatives suggested is to consider the requirements of calories at a level less than the average (by about 15 per cent) as this could be treated as a critical level below which the normal functioning

of the human system is jeopardised. The alternative advocated by Sukhatme contains a number of questionable assumptions. At this stage, it would be useful to recall from one of our previous reports (Integrated Nutrition Planning Models).

There are two distinct issues connected with the above problem. One is the relationship of prescription of minimum calorie requirements with the assessment of poverty (based on which certain economic development programmes are drawn up); the other is the realistic prescription of nutrition requirements, assuming certain questionable features. In the first case, if the problem is considereJ from the point of view of elimination of poverty, in the backdrop of prevailing under nutrition problem in the country, it should be possible to confine the development priorities (given the limited scarce resources) to the worst affected; infact, this is what exactly the Sixth Five-Year Plan (in schemes like the IRDP, aimed at economic welfare) suggests. A fine distinction of requirements marginally below average or the usual average specification of requirement of calories being made at the household level would then be only of theoretical/statistical relevance.

In the second case, a number of practical issues become relevant while specifying nutrition requirements. For example, it may not be sufficient to go by standard anthropometric measures to prescribe calorie requirements—since it is not entirely clear at any level of policy whether we want to stabilise the population at the present average levels of height–weight or would like to enhance the physiological characteristics. Also, what is functionally needed is a height–weight combination for different categories of population engaged in various types of occupations (that is what is needed for an "economic man"). This would warrant some understanding of the linkages between nutrition, growth, and physical development and productivity in the long-run. Clarity about the requisite catch-up growth regarding child development is essential for

precription of nutrition requirements. Accordingly, the end–products of nutrition specifications in terms of the above parameters are to be clarified before attempting any specific prescriptions. Linked to this are also the undermentioned important practical issues which limit the precision of estimation;

1. Choice of sampling methods, that is, coverage of population, sampling data collection at different time intervals, ensuring the same physiological parameters to be maintained, isolating the role of other influencing parameters affecting nutrition studies, etc, and ensuring that the estimation biases are minimised *(and preferably should remain invariant to small changes in sample design characteristics) ;

2. Identification of "reference" persons for the above exercise in the assessment of normal requirements.

The above considerations point to the irrelevance of much of the debate on the controversy of prescription of minimum nutrition requirements. We, therefore, suggest specific norms to be evolved, this requires considerable clarity of objectives before such norms are prescribed. Also, the implications of alternative levels of specifications of nutrition requirements, in physiological and economic terms, should be assessed. The critical limit (suggested below the specified average level of requirements given in the norms prescribed by the ICMR) proposed by Sukhatme might in some cases ensure normal physiological functioning of the human system, but this criterion ignores (i) the possible positive correlation between physical productivity and intake of nutrients (especially calories in case of adults) above the critical limit, and (ii) the implications of prescribing such limits on catch-up growth, in respect of critical nutrients for children.

---

*Statistical literature indicates the non-existence of unbiased estimators of mean in general categories of sampling designs; particular cases, however, qualify.

The myth of accurate specification of nutrition requirements is far too elusive and, therefore, the estimation of poverty based on this norms is also bound to be frought with these, and also additionally the underlying assumptions in linking up definitions of poverty and of nutrition requirements A point of departure from the conventional debate arises when we realise that the intake of specific nutrients is not necessarily an end product in itself for any economic or human system Economic productivity, longevity, mortality and morbidity, physical and mental well-being (including indicators of health), etc. would be relevant end-products, the attainment of which depend not only on intake of nutrients but a number of other factors (economic and non-economic), the most important being the biological utilisation of any given level of intake of nutrients. The utilisation factor, in turn, is dependent upon a number of parameters specific to individual physiological system and its environment (household level, village and area level, etc.). Hence, the need for a comprehensive integrated approach to the problem of nutrition development.

2

Modes of Intervention

It is well recognised that economic growth (or higher incomes at the household level) is more often a necessary but not a sufficient condition for ensuring the intake of physiologically required nutrition. With the prevalence of the widespread under-nutrition, the time normally required to bridge the nutrition gap is expected to be more than that four to five decades in the case of India (some of the studies of the World Bank indicate the time required to be around three decades). Therefore, if the adverse socio-economic and human consequences of under nutrition are to be minimised, in the short run (up to about one decade) the public policy cannot rely entirely on the market price mechanism or leave the economic system to settle for any degree of malnutrition in the society. Here lies the important role of the intervention (whether direct or indirect) mechanism.

There could be a hierarchy of intervention mechanisms that can be evolved, distinguished by time-phases, regional aspects, sectoral/administrative agency specific programmes as well as target-group-oriented ones; a mix of these operate in practice in most of the States. Since there is neither a central authority specifically empowered to co-ordinate direct and indirect intervention mechanisms affecting nutrition status in a targetted manner nor the information system presently capable of providing information on efficacy of different polices and programmes (in terms of first-order and higher-order impacts responses), a "general equilibrium approach" leading to the optimisation of resource allocation process to

achieve nutrition objectives is operationally less feasible,to be of practical use. "Partial equilibrium approach" would perhaps be more pragmatic; approximations of this approach are useful and are considered elsewhere. Formal optimising methods for the integrated approach were evolved in a previous report entitled Integrated Nutrition Planning Models. However, an appreciation of the elements of intervention mechanisms and possible evaluation of performance/impact of specific policies and programmes with reference to specific components of the same would be better done if the structural configurations of the system and relationships with desired objectives could be logically and quantitatively related.

In general, there are several possible modes of intervention that could be considered in affecting nutrition and health status of the targeted groups of population, so as to achieve the desired objectives, The interventions can be classified in several ways, for instance, in terms of price and non-price intervention strategies. These could also be asserted in terms of those which affect the intake of nutrients and are rather affect biological utilisation of specific levels of intake of different nutrients. These could be characterised via a number of socio-economic development programmes or could be treated as additional efforts for improving the nutrition status of the society. In the later category, a number of familier methods of interventioe like supplementary feeding, fortification of food items, etc., may be considered. Also, the strategies could be specific to certain time intervals like food and nutrition supplementation, any drought periods of long-term strategies like nutrition education.

An integrated approach to nutrition intervention calls for a comprehension of all these parameters and then evolving an optimal mix of strategies for the targeted groups of population in order that the desired enhancement in nutrition status is achieved. Normally, one would look for linking of alternative strategies along with the appropriate discount rate to be

applied for future benefits, based on a common scale of costs and benefits. The benefit–cost ratio would be a useful indicator if common numerior of benefit and of costs could be established. However, since the target groups of population and the corresponding nutrition programmes are likely to be different (mainly distinguished by age groups and the specific benefits to be derived by these age groups differing), the benefit defy easy comparison and quantification. What is practicable is a cost–effectiveness approach that would attempt to link alternative programmes for each of the targated groups so as to enable trying a mix of programmes. Again, this would warrant considerable information on the efficacy of different programmes. As seen in a different report (coordination, Monitoring and Evaluation of Nutrition Programmes), it is hard to obtain the relevant information for this purpose and hence the difficulty in evolving the judicious combination of alternative strategies. However, it is extremely importhan to note that any costing exercise for this purpose should not take only the administrative costs but the cost of affecting unit benefit to individual targeted beneficiary (that is, the cost should be inclusive of wastages and linkages, and other inefficient utilisation features).

In order to integrate the various aspects of nutrition development, and to bridge the gap between demand and supply of nutrients, it is necessary to get an overview of the production and consumption subsystems of the economy. The elements of cost effectiveness approach should take into account the intervening parameters, deficient effects, sensitivity of impact with respect to different types, and the magnitudes of intervention in addition to comparability. Among the specific indicators, that could be evolved for nutrition evolution purposes are cost per closing specific nutrient gap per individual The cost per change in degree of malnutrition, cost per change in mortality rate, the logistics of distribution of commodities and services under different nutrition programmes (like on-site feeding or take home.

etc.,) are very important factors in the assessment of the different programmes.

The integrated nutrition programme should recognise the interaction, which includes components having indirect relationship to nutrition status, such as quality of water, family planning, health, etc.,in addition to components which directly affect the nutrition status. The recognition of the linkages between the components of integrated interventions can provide considerably higher efficiency and effectiveness than designing separate systems of action. The intervention design should take into consideration social-biological linkages, in addition to the implications of popuiation policy and quality of life. The principles useful here in calculating and controlling costs in the integrated intervention strategies are the following:

> Prioritisation of the problems based on morbidity/mortality of the under five-year olds will reduce the leakages and most efficiently indentify the areas warranting intervention.
>
> Employ cost effectiveness analysis when deciding on the programmes entailing resource allocation.
>
> Keep in mind the concept of marginality — once a programme is functioning, the addition of certain services may entail minimal extra costs.
>
> Consider cost to the individual, cost of the institution and psychological costs when determining the programme design.
>
> Disaggregate costs of delivery of the integrated programme into component costs to demonstrate supplementarity and savings derived from co-ordinating operations.

The cost of a programme with the objective of increasing child food consumption may be decomposed into (i) the cost

of the intra-family leakage, equivalent to the subsidy on adults' consumption in poor families that is necessary in order to achieve the objective; (ii) the income group leakage, the subsidy received by non-target families out of the programme; and (iii) the administrative costs of the programme.

Effectiveness of Target-oriented Food Problems

For the purpose of comparing programmes, the effectiveness of an income transfer programme is used as common numeraire. It is useful to investigate the conditions under which the target food programmes are equally effective as income transfers of a value equal to the food being distributed—in this case the effectiveness of the programme is determined by the household's marginal propensity to spend in children's food; parameters other than this can also be effective.

a) *Programmes equivalent to an income transfer* :

Any transfer / invention in the kind of a food commodity in excess of what the household voluntarily is willing to consume if sold to households with different food preferences or households not reached by the programme, and if the resale price is similar to the cost of the food to the government, the household receives an income transfer equivalent to the fiscal cost of the programme (excluding the administrative costs). In this case, the programmes will simply have an effect equal to an equivalent income transfer. The effectiveness of income transfers in increasing the consumption of food by children is proportioned to the marginal propensity to spend in children's food; the effect on calories will depend upon the calorie content of that additional food, calorie income elasticity would be an useful indicator.

(b) *Income transfer equivalency without resale* :[1]

Programmes that transfer free or subsidised food in magnitudes smaller than the amount previously consumed by the

1. Some of the relevant investigations are carried out in Selowsky M ; the Ecomic Dimensions of Maluutrition in young children World Bank Staff Working Paper No. 294, 1978.

family will replace initial levels of consumption and release the purchasing power of a value equal to the subsidy. When more than one food is involved in the programme, two conditions are received : (i) the foods being distributed must have been previously being consumed, and (ii) the amount of any food being distributed cannot be larger than the amount initially being consumed—these conditions leave unaffected the marginal rate of substitution among foods,the condition for the programme to act like an income effect. The cost effectiveness is defined here as the fiscal cost of increasing the aggregate food consumption of children and not the per capita consumption by each child. The Calcutta Survey[2] gives individual's marginal propensity to consume in the case of children of 3-5 years at 0.06, and for adults as 0.08, corresponding to the poorest 58 per cent of households.

As expected, a very narrow definition of children makes all programmes more cost effective than an income transfer. There are three ways of assessing the effectiveness of target oriented food programmes : (i) programmes which are as equally effective as income transfers of a value equal to the food being distributed ; (ii) programmes which can be of a larger or smaller effectiveness than an equivalent income transfer ; and (iii) parameters other than the marginal propensity to spend in children's consumption (as in case (i).

In order to assess the impact of feeding programmes on children nutrition status we need the cross-price elasticities at the household level, apart from the intra-family distribution properties. This information is only partially available. If milk and cereals are substitutes, the percentage charge k_m in calorie consumption reduced by a one-per cent decline in the price of milk can be written as :

$$K_m = \alpha_M \eta_{MM} - \alpha_c \eta_{CM}, \quad \alpha_M + \alpha_c = 1$$

where α_m and α_c are the initial shares of calories derived from milk and cereals, respectively ; η_{mm} the (own) price

2. USAID. A Study of Food Habits in Calcutta. New Delhi, Hindustan Times. Nov. 1972.

elasticity of demand of milk and (η_{cm}) the (gross) elasticity between cereals and milk (η_{cm}) is assumed - ve cross here—as both foods are (gross) substitutes.

$$K_m \text{ is -ve if } (\alpha_M/\alpha_C) < (\eta_{CM}/\eta_{MM})$$

If $\alpha m/\alpha c = 1/5$, any cross elasticity larger than one-fifth the value of the price elasticity for milk will induce a negative effect on calories.

Based on Calcutta Survey [3] it is found that the direct site feeding with a food as calorie-intensive as cereals is, even in the worst case[4] one-sixth the cost of a price subsidy of that food to the target households and almost one-fifth the cost of income transfer. (The estimated K_i : calorie elasticity of children with respect to price of food i is given by 0.33 for cereals and 0.16 for milk and 1.00 for typical diet as in case of bottom one-third families).

Implementation Issues

When food prices do not work complimentary to the objective of greater food consumption by the poor, the sectoral programmes and targetted delivery schemes with the same goals are likely to be ineffective or costly in their effectiveness. Evolving and implementation of food price policy interventions should, therefore, be co-ordinated with planned interventions at other levels of the problem. The discussions must deal with four basic requirements for a successful intervention to improve nurritional status : the (1) demand requirement, (2) supply requirement ; (3) delivery requirement ; and (4) sustainbility requiremenr. Intersecting these four pro-

---

3. USAID. A Study of Food Habits in Calcutta. Opcit.

4. Assumption : When the family fully corrects for the differnce in calorie intensity-if the site food has only half the calories per Rupee than the home food, then $10 worth of site food is equivalent to $5 worth of home food.

gramme requirements are four levels of strategic design (Peter Timmer [5])

(1) Structural changes leading to significant asset redistribution and to more equitable functional income distribution, thus providing the poor with better access to food because of long-term improvements in real purchasing power;

(2) policy changes in the macro environment that affect the rate of economic growth, the degree of participation of the poor in that growth, and further improvements in real purchasing power ;

(3) sectoral interventions designed specifically to improve the access of the poor to basic goods and services, such as a well designed and managed rural health-programme or agricultural development programme designed for small farmers: and

(4) targeted delivery systems for either single commodities or integrated basic needs packages focused on the needs of the poor.

"The essence of a package oriented targeted delivery strategy of meeting the needs of the poor is that the first three reqirements are intimately interlinked. At its simplest, such a strategy succeeds because delivered supply creates-its own demand. But the welfare-oriented, transfer nature of this simple strategy has raised justifiable concerns in poor countries over its impact on economic growth and over the long run sustainability of the recurring fiscal burden".

It is feasible to pursue a package approach at the village level without any broader concerns for sectoral strategy, policy setting, or asset redistribution and functional changes in income distribution. The efficient sectoral interventions are likely to require integration with package appro-

---

.5 Timmer C.P. Food Price Policy and Nutrition Intake .1981, (Mimeo).

aches if the poor are actually to be reached and benefited, but such sectoral/package strategies can be implemented without macro policy set, but will require appropriate sectoral and package interventions. The income redistribution, especially through asset redistribution, such as landreform, is unlikely to have any lasting (or even short run) impact on the poor without simultaneous attention to policy, sectoral, and packaging delivery/issues.

Cost Effectiveness - A Framework

Although analysis required under Cost-Effective Approach (CEA) is rather well-known, its application in the nutrition sector might require some elaboration. As argued in earlier Reports of the Study, utilisation of nutrients (U) is as important as intake of nutrients (I) because of inefficient utilisation in most part of India contributed by various environmental features like infection, bad quality of water and air, etc.

$$U = f_1 \ (I, [X]\ )$$

where $I = f_2 \ ([E], [Y]$

where [X] depicts the set of environmental factors,

[E] set of economic factors affecting the household consumption of nutrients,

[Y] set of direct and indirect interventions aimed at enhancing intake of nutrients of desired groups of population and f_1, f_2 relevant structural functions.

The cost of affecting an increaee $\triangle I$ is to be assessed as a sum of direct costs (administrative) of intervention C_0 $(\triangle I)$ and indirect costs $\sum_{i=1}^{n} Ci \ (Y_i)$ where n is the number of interventions and $C_i \ (Y_i \ ) = 9_i \ (A_i, \ M1_i, \ OC_i, \mu)$ (i : programme suffix) where Ai is the degree of

acceptance (potential beneficiary participation in the programme), MI_i cost of monitoring and evaluation functions, OC_i opportunity costs of alternate uses of resources made available under the progra nmes (opportunity costs accruing to the household when potential be neficiaris participate in the programme and those accruing to the implementing agencies) and μ the parameter depicting situational/local variations of institutional features.

It may easily be seen that:

$$\frac{\partial^2 I}{\partial E \ \partial E} \neq 0, \qquad \frac{\partial^2 Y_i}{\partial A_2 \ \partial E} \neq 0,$$

$$\frac{\partial^2 Y_i}{\partial Me_i \ \partial OC_i} \neq 0, \qquad \frac{\partial^2 Y_i}{\partial A_i \ \partial OC_i} = 0,$$

$$\frac{\partial^2 Y_i}{\partial A_i \ \partial MI_i} = 0, \qquad \frac{\partial Y_i}{\partial MI_i} > 0,$$

$$\frac{\partial Y_i}{\partial OC_i} < 0, \qquad \frac{\partial Y_i}{\partial A_i} > 0,$$

Assessment of Impact of Interventions

For assessing the impact, one needs to examine the issues: (i) how does the indicator whose performance is being assessed, relate to the ultimate desired objective/outcome/indicator?; (ii) how does it statistically correlate to the final or intermediary desired objectives (assuming a multi-level translation of nutrition development objectives)?; (iii) how reliably it can be measured?; (iv) what complementary information is needed?; and (v) what are the costs of obtaining and using the information? Some of these issues are examined in the supplementary Report Coordination, Monitoring and Evaluation, taking among other things, the administrative features governing the implementaion of various nutrition programmes in Tamil Nedu.

3

Integrated Approach and Operational Strategy

Optimising Framework

The discussion in the previous chapter is a pointer to the vivid possibility of evolving an analytical framework which can integrate different possible interventions. Also, the need for optimising framework was advocated in detail in a previous report (Integrated Nutrition Planning Models) and also briefly discussed in the previous chapter. After a survey of the available published literature, various alternative formulations were indicated in the report and many of them were also calibrated using some hypothetical trial data. Some of these with minor adjustments (depending upon the availability of data and other institutional features) could be utilised by the State Government for evolving an integrated strategy. However, it was already noted that considerable further effort on the part of the Government is needed to gather and compile several types of data before attempting to operationalise the models evolved in the previous report.

In the mean time, it is felt that effort should be initiated to collect at least essential information requirements is a list of information requirement indicated in Annexure–2. This is not a comprehensive information list as it does not include various relevant indicators and factors affecting systems like agricultural production, food processing, marketing and civil supplies, etc. The list would enable primarily an assessment of nutrition and health status of the population with appropriate grouping of sections and some tentative segmentation. Since the implementation of formal optimisation models is likely to be a cumbersome

exercise at this stage for many of the States, it is felt that certain administrative arrangements might help to improve operational planning and implementation. For this purpose, attempts were made to review the existing arrangements of co-ordination of different nutrition programmes: as a matter of primary interest the case of Tamil Nadu was taken for a detailed investigations. Also, some of the features governing the co-ordination at the Union Government level were also briefly examined.

Non-optimising Framework

Primarily, in this approach it is attempted to review formal and informal methods of planning, co-ordination of different nutrition programmes, as well as monitoring and evaluation of the same, as practised, both at the Central and at the State levels. As regards the analysis at the State level, it was confined only to Tamil Nadu. A detailed study of the need and scope for improved co-ordination, monitroing, and evaluation is provided in the form of a supplementary report entitled Co-ordination, Monitoring, and Evaluation, along with this report. It must, however, be noted that a lot more analysis and understanding is required as regards the role of political and social factors, especially the contribution of the recently launched mid-day-meal programmes and a few other internationally supported programmes in Tamil Nadu. An analysis of this type would throw more light on the relevant contributions, different factors to the desired indicators of nutrition and health development.

Monitoring function generates information based on improved quality of decisions, mainly in respect of effective implementation reducing costs and time to minima. Evaluation of programmes will help proper future planning so as to optimise the scarce resources. Co-ordination can be treated as a process of decision-making based on a set of guidelines and information based on monitoring and evaluation. The

value of information may be defined as the net gain in resources for attaining specific levels of nutrition development. The costs (direct and indirect) of co-ordination, monitoring and evaluation should, however, be recognised. Often, the costs are much less compared to benefits that can accrue as a result of these functions.

The objective of the supplementary report is first to briefly examine the co-ordination aspects at the national and the State (in respect of Tamil Nadu) level and explore possibilities of improved co-ordination. Since child nutrition is an area of utmost importance, the suggestions contained in various expert committee reports have briefly reviewed. In the subsequent sections the normative and practical aspects of monitoring and evaluation are discussed with an analysis of evaluation studies dealing with some of the nutrition programmes. Possibilities of improving co-ordination, monitoring and evaluation are also examined.

The important pre-requisites for an effective co-ordination may be summed up as under :

1. The political will and administrative commitment to achieve improved results—results not based on expenditure statistics or resource allocation indicators, but based on factual information relating to type and magnitude of nutrition benefits (whether based on clinical, anthropometric or other measures of improved nutrition status—or as a next approximation, to improved intake of nutrients by target groups).

2. Proper composition of the co-ordination committee representing various departments/agencies involved in policy formulation and implementation of schemes which have direct and indirect bearing on nutrition status of target groups ; this would also include the proper selection of the chairman of the committee mainly based on his status in the government so that the chairman can effectively control various activities and give directives to various departments and other agencies.

3. Information base for decision-making is an important consideration for effective functioning of co-ordination activities. Availability of dependable and timely data based on various surveys, monitoring and evaluation activities on time ; this includes evolving feedback information systems for proper planning and implementation, and timely action for corrective measures.

4. The frequency of meeting should be need-based, that is, depending upon the type and intensity of different activities and seasonality, the meetings should be held ; it appears that quarterly meeting is a must for any effective co-ordination.

Among the conclusions arrived in the analysis carried out in the supplementary report are :

(i) The functions of Food and Nutrition Board can be more effectively operationalised with strengthening of expertise and necessary staff. Although the description of functions of the Central Co-ordination Committee provide a wide scope for the integration of various activities, the information base for decision-making must be strengthened by creating monitoring and evaluation cell. At the State level, monitoring and evaluation cells may have to be created to deal with operational aspects, including implementation and effectiveness of different programmes.

(ii) There is an urgent need for survillance of poverty and periodic quantitative assessment of type and degree of malnourishment/poverty. The institutional arrangements may have to be made to accomplish this task.

(iii) A high power National Committee on Nutrition is needed with the Prime Minister as Chairman and all Secretaries of all the economic ministries/departments and those dealing with different nutrition programmes as members so as to ensure an effective co-ordination. Alternatively, the

National Children's Board (formed in 1974) can take more effective steps in co-ordinating the programmes relating to children which form the main thrust of the activities ; this would require strengthening the Board with skilled manpower and organising the relevant data-base system enabling an effective decision-making. Constituting of a sub-committee which can serve as a Standing Committee of this National Committee would be useful, so that it can meet at desirable frequencies.

4

Further Research Needs

An approach of synthesisation enabling the government to priorities and identify areas for further research is an urgent necessary. Accordingly, the following write-up indicates the role and relevance of some of the identified areas for further research. A comprehensive list of areas for further investigation has been drawn up by the Multi-disciplinary Committee on Nutrition, set up by the Planning Commission, New Delhi (1979).

1. The fundamental problem of assessment of nutrition requirement and the consequential assessment of poverty is still a controversial issue. The debate generated by various researchers is only a part of the overall analysis required for proper appreciation of the dimensions of the programme. It would be useful if a national institute like NIN or an entirely new organisation could undertake (on the basis of carefully and properly statistically designed study on the requirements) to provide the empirical basis. Also, indepth studies on metabolic factors and their role in assessing nutrition requirements would be useful.

ISSUES :

(i) If proverty is defined in terms of ability to consume the average calorie requirements, the surveillance of poverty should take this important indicator into consideration. How to account for the inter-individual and intra-individual variations in nutrition requirements and how to evolve average calorie requirements of an average household and how to take family unit as base for poverty norm.

(ii) Empirical indications are that with marginal increase in income levels, the food preferences undergo significant changes in the lower income strata of population and such increases in income do not necessarily contribute any improvement in nutrition intake and hence in the improvement of poverty situation in the country. In this context, what could be the role of nutrition education in alleviating poverty so defined?

(iii) How to define proverty, considering the heterogeneous environmental factors which have a bearing on metabolic absorption of nutrients i.e., since the average calorie requirement can vary with respect to the features governing other nutrition related factors like quality of water, hygiene, etc., how to define poverty on a location specific/region specific/State specific basis?

2. The impact of the various nutrition programmes in operation is rarely properly assessed. Evaluation studies should be carried out at the earliest before finalising the investment of resources in a number of nutrition programmes.

ISSUES :

(i) A manual, covering the guidelines for monitoring and evaluation is essential and the manual should be made specific to each of the nutrition progrmmes being implemented.

(ii) A clear definition must be maintained about the operationalising concurrent evaluation and monitoring systems as an important pre-requisite for successful implementation of nutrition programmes, and ex-post evaluation should be separated from function although it is related to this. Accordingly

guidelines for short-term monitoring and concurrent evaluation programmes.

(iii) Clarity about the objectives of each of the programmes is an important pre-requisite for evaluation of the programmes and, therefore, specification of a hierarchy of objectives for each level of implementation as well as for each region or section of targeted population is important.

(iv) Evaluation of impact of nutrition programmes with reference to the objectives should be carried out as a matter of standard practice rather than an exception. It is desirable to examine the organisational requirements and staffing pattern, etc., in order to carry out these activities as well as other monitoring and concurrent evaluation activities.

3. Although integrated nutrition planning models have been developed by the ASCI studies, these have to be improved further; there is need to make them increasingly realistic and operationally more useful, especially from the point of view of the State governments. (In this context, it must, however, be clarified that the present system of treating nutrition programmes almost as a charity programme and incorporating these as a part of several other special welfare activities and entrusting with the Social Welfare Department may not be the best way of dealing with the multi-nutritional problem in the country).

ISSUES:

(i) Administratively, how to integrate food and nutritional policies once evolved, and what arrangements needed for monitoring impact, possibly by the Department of Food.

(ii) Role of Social Welfare Departments in respect of those programmes which are drawn only from the social welfare point of view.

(iii) the State level co-ordination as well as project level co-ordination, the span of control and integration of activities across different departments which have functions relating to alleviation of mal-nutrition along with information system needs to be evolved for an efficient co-ordination and monitoring.

4. Detailed social cost-benefit analysis on project appraisal of different food processing technologies and systems is an important prerequisite for formulating national as well as State level policies. These studies need to be initiated at the earliest.

ISSUES ;

Choice of technology for different types of food processing, including food preserving, should be governed in a broader socio-economic framework. The social cost-benefit analysis of alternative technologies leading to choice of appropriate technology could be a useful approach for investment decisions in the public sector, if the government invests in certain categories of food processing, and also for evolving guidelines in respect of control regulations and support for different types of food processing industries in the private sector. The financial subsidies and other incentives could be formulated differently after detailed analysis of social cost-benefit implications of alternative technologies is carried out.

5. In-depth analysis of agricultural production response to different incentives via agricultural inputs (especially to

the pricing of fertiliser, etc) would be a useful exercise. Also, the impact of alternative agricultural output pricing on the net availability of nutrients should be assessed in select few cases.

ISSUES :

The nutritional implications of the various role development programmes, especially NREP, DPAP, IRDP, etc, should be carefully examined and ways and means of integrating nutrition dimensions in various micro-level schemes in rural areas being undertaken at the local level (with or without support from the higher levels) should be analysed. It should be possible to synchronise the nutrition development objectives with other economic development objectives like unemployment reduction, welfare of vulnerable group, etc. Other schemes like employment guarantee scheme, unemployment allowance, etc. should also be examined from the point of view of improved nutrition status.

6. Since nutrition is not necessarily an end-product in itself, empirical relationship between the varying levels of nutrition intake in conjunction with different environmental parameters with a bearing on health status should be established in select few regions.

ISSUES :

(i) If health status (defined properly using an index) or morbidity indicator is taken as relevant factor that could be monitored, what are the relative roles and contributions (by magnitude) of different inputs like environmental parameters (quality of water, hygiene, etc), and intake of different nutrients (defined by type and magnitude) in various regions of the country ?

(ii) What are the cost (direct and indirect) implications of effecting change in morbidity *via* effecting intake of nutrients (both in the mix of nutrients and levels of intake of different nutrients) ?

7. Since child nutrition is the top priority in nutrition development, further investigation based on empirical data are necessary ; these could analyse the inter-play of nutrient intake environmental and socio-economic parameters (including cultural factors) in explaining the pattern of morbidity. For the purpose of this analysis, it may be noted that considerable data are available on a large-scale at the Institute of Child Health, Madras, as well as a few other hospitals like Niloufer Hospital, Hyderabad, CMC, Vellore, and AIIMS, New Delhi.

ISSUES :

(i) What is the correlation between the different factors regarding which information is recorded in the standard formal of medical statistics available with the select institutes in respect of child health ?

(ii) What are the policy implications of the above in terms of preventive and curative steps for improving infant mortality and child morbidity ?

5

Gaps Between Requirements and Production

Food gaps have been estimated based on two approaches: (1) Gap between production and requirement; and (2) Gap between effective demand and requirement. The assumptions involved in estimating production are the following: (a) the factors affecting production will continue to prevail as in the past (as reflected in the trend relations making use of data for the period 1966–67 to 1978–79); (b) the inter-year and intra-seasonal fluctuations, due to significant changes in rainfall, are accounted only in the form of an average trend, that is, the fluctuations are ignored; (c) the growth rate depicted by the trend relations is likely to be much higher than what is assumed in the Sixth Five-Year Plan of Tamil Nadu which indicates about more than 1 per cent growth rate in irrigated agriculture. Accordingly, commencing from the year 1981–82, the slopes of the trend relations have been so adjusted that for the next five years the assumed growth rate in agriculture is only around 1.5 per cent. Evidently, this is an approximation and does not recognise the possible higher productivity, compared to the past; the possible discrepancy, however, is likely to be marginal. The district-wise forecasts of production, based on trend method, alongwith the corresponding aggregates for the State, are provided in Annexure 3 (Tables 1—4), only in case of State level forecasts, the adjusted growth rate of 1.5 per cent has been used to provide the estimates of production (which are obviously lower than those based on trend method). The deviation in trend and application of 1.5 per cent growth rate was applied commencing 1981-82. Further discussions on

the irrigation growth in Tamil Nadu and relative stagnancy in it is provided in a later sub-section in this chapter.

As regards the assessment of requirement, the basis has been the traditional pattern of food consumption aggregated for the entire population in the State for the period 1966-67 to 1978-79. Also, the ICMR prescribed norms of nutrition requirements (1968) have been used and calorie has been taken as the common numeraire for the conversion of calorie requirements into food requirements. In this approach, we are assuming two features ; (1) the traditional food habits will continue and should be recognised as considerably rigid factors in consumption habits ; (2) calorie being a major deficient nutrient, the equivalent food requirement is a major guiding factor in the assessment of food requirements as well as subsequent gaps. Clearly, if one take some others nutrient for the purpose of conversion of nutrition requirements into food equivalent, the estimates of food requirements will vary, possibly considerably. This would be particularly true if another major deficient nutrient, namely, vitamin A is taken as a basis. It has been observed earlier in our reports (Demand for Nutrients) that with the traditional food consumption pattern it is very unlikely that vitamin A deficiency can be met in the near future in the State. Some of the alternative solutions for this purpose were also suggested earlier. As regards the revised ICMR norms prescribed in 1981, it has been noticed that marginal changes have been suggested in terms of calorie requirements for adults and children. However, the net effect of these changes at the level has been found to be almost negligible, considering the age distribution of the population in Tamil Nadu. These effects have been taken into account and the demand implications were assessed in the Report Demand for Nutrients.

The gap between requirements and effective demand is estimated in order to assess the role of market factor, mainly

prices and incomes, in determining the purchasing power and effective intake of different foods so that wide gaps if any, can be taken to be those which cannot be expected to be met in the normal course of growth and development activities. In such cases, it would be desirable to ensure that purchasing power is improved and in the short run special measures are adopted (like food-for-work or related schemes) so that short-term-and long-term solutions for bridging the gaps are obtained within and outside the existing framework of development activities (including nutrition intervention programmes and on-going schemes).

Tables 1 and 2 provide the estimates of food gaps between the requirements and production, where the production estimates are based simply on trend method (and not adjusted for possibly decelarated growth in irrigated agriculture). The purpose of these projections is mainly to indicate the possible food gaps based on rather optimistic assumptions of continued pace of agricultural production growth in Tamil Nadu. Thus, the percentage gaps and the corresponding quantities could be treated as lower bounds for the same; the real gaps may be slightly higher.

TABLE 1 : Food Gaps between Requirements and Production in Tamil Nadu
(Based on trend method)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	742.0 (12.0)	741.7 (11.7)	741.1 (11.5)	753.5 (11.5)	732.5 (10.9)	740.4 (10.9)
All Cereals	927.2 (10.9)	911.1 (10.6)	894.4 (10.2)	895.4 (9.9)	870.9 (9.5)	846.0 (9.1)
Grams & Pulses	279.9 (56.7)	283.2 (56.3)	286.6 (55.8)	290.9 (55.5)	292.7 (55.0)	296.0 (54.7)
Vegetables	-172.8 (-17.0)	-182.7 (-17.6)	-192.6 (-18.2)	-200.3 (-18.6)	-213.6 (-19.5)	-296.7 (-19.9)
Fruits	527.8 (20.0)	558.5 (20.7)	599.0 (21.8)	645.1 (23.0)	676.9 (23.8)	721.1 (24.8)
Milk	-172.8 (-12.5)	-166.5 (-11.9)	-160.3 (-10.1)	-151.1 (-10.3)	-149.3 (-10.1)	-141.1 (-9.3)
Starchy foods	-887.7 (-98.0)	-955.2 (-103.4)	-1032.8 (-109.6)	-1108.7 (-115.3)	-1189.3 (-121.8)	-1265.6 (-127.1)
Sugar	122.3 (11.3)	109.0 (9.2)	95.7 (8.5)	84.5 (7.4)	67.7 (5.8)	55.8 (4.7)
Fish	52.3 (12.1)	55.5 (12.6)	58.6 (13.0)	62.6 (13.6)	64.3 (13.8)	68.0 (14.3)

(Figures in brackets are percentages of gaps between requirements and psoduction).

TABLE 2 : Food Gaps between Consumption and Production

('000 tonnes)

Commodity	1981–82	1982–83	1983–84	1984–85	1985–86	1986–87
Rice	584.8 (9.7)	672.5 (10.8)	763.7 (11.8)	863.9 (12.9)	954.8 (13.9)	1056.4 (14.8)
All Cereals	422.5 (5.3)	485.9 (5.9)	554.7 (6.6)	635.2 (7.3)	700.8 (7.3)	883.5 (9.5)
Grams & Pulses	279.2 (56.7)	287.8 (56,7)	300.5 (57.0)	304.3 (56.7)	310.9 (56.5)	318.2 (56.5)
Vegetables	—322.4 (—37.2)	—328.4 (-36.9)	—320.6 (—34.5)	—340.4 (—36.3)	—346.7 (—36.0)	—351.6 (—35.6)
Fruits	—460.6 (—27.7)	—476.0 (—28.7)	—495.2 (—30.0)	—513.8 (—31.3)	—535.7 (—32.8)	—559.0 (—34.5)
Milk	—47.1 (—3.1)	—51.0 (—3.4)	—55.2) (—3.6)	—51.0 (—3.3)	—66.9 (—4.3)	—74.5 (—14.7)
Starchy foods	—1172.1 (—191.7)	—1218.2 (—184,4)	—1282.2 (—185.3)	—1325.1 (—177.9)	—1388.2 (—178.7)	—1429.5 (—172.0)
Sugar	434.7 (31.3)	445.2 (31.0)	456.5 (30.8)	470.2 (30.8)	500.9 (31.4)	514.5 (31.3)
Fish	—9.6 (—2.6)	—8.0 (—2.1)	—6.4 (—1.7)	—4.4 (—1.1)	—23.2 (—6.1)	—22.0 (—5.7)

(Figures in brackets are percentages of gap between consumption and production).

Need for Adjusting Trend Projections

There is no remarkable change in the cropping pattern in the State since the last 28 years. An average of 75 per cent of the land was utilised for food and the rest for non-food crops. Rice accounts for more than two-third of the total irrigated area. Table 3 gives the area under different food-grain crops, their achievements and targets as furnished in the Tamil Nadu Sixth Plan Document :

TABLE : 3 Achievements

	Achievement 1979–80 (lakh hectares)	Proposed target for 1984–85 (lakh hectares)
Rice	28.51	26.50
Maize	0.22	0.50
Jower	7.15	8.30
Bajra	4.14	4.80
Ragi	2.87	3.50
Other cereals	3.90	3.00
Pulses	7.01	15.50
Total	53.80	62.10

About 6.5 lakh hectares are cultivated with various horticultural crops. Wells are the major source of irrigation in the State which covers 33.78 per cent of the net area irrigated. The special minor irrigation programmes aim at tapping the flash-flows in minor rivers and jungle streams by forming new tanks, construction of anaicuts, excavation of supply channels, conversion of the existing mud "kondams" into masonry weirs and formation of ponds for raising the ground water table in order to bring under cultivation new ayacut, busides bridging the gap, stabilising the existing ayacut, etc. It appears that there is no further scope for any major river valley projects in the State since 95 per cent of the surface

flow has already been utilised according to Sixth Plan of the State.

Thus, there is a strong need to take into account the reality of the agricultural system in Tamil Nadu as it is not able to keep up the pace of growth due mainly to near stagnancy in growth of irrigated agriculture. The alternatives seem to lie in making efforts to increase the yield rates/productivity of land and water, inter-cropping, introducing new short-duration HYVs in different food crops, etc. The revised production estimates based on the projected 1.5 per cent growth rate in agriculture, applied to rice and cereals and the resultant food gaps are furnished in Table 4.

Table

TABLE 4 : Revised Production and Gap Estimates
(Based on trend projections corrected for 1.5% growth)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice (P)	5449.7	5531.4	5614.4	5698.6	5784.1	5870.9
Cereals (P)	7531.4	7673.6	7817.1	7962.0	8108.0	8255.3
Rice (G)	742.0	782.2	820.8	871.1	886.8	930.1
	(12.0)	(12.4)	(12.7)	(13.2)	(13.3)	(13.7)
Cereals (G)	927.2	951.6	974.1	1013.0	1005.2	1035.7
	(10.9)	(11.0)	(11.1)	(11.3)	(11.0)	(11.1)

(Figures in brackets are percentage of gaps to requirements) P : Production ; G : Gaps.

The district-wise production of rice and cereals is based on trend method and does not reflect the tappering off of the growth rate in most districts due to reduced anticipated growth rate in irrigated agriculture. Accordingly, the estimated gaps are likely to be underestimate in respect of various food items. However, at the aggregate level for the State as a whole, the anticipated growth rate of more than 1 per cent in irrigated agriculture has no recognised and the trend projections have been accordingly adjusted with the growth rate of 1.5 per cent to furnish us more realistic estimates of production.

District-wiss food gaps

Tables 5 to 18 provide district wise food gaps between requirements and production Requirements, as done earlier in the report, have been calculated on the basis of population projections provided by the Tamil Nadu State Planning Commission (age-distributions are also made use of) ; the ICMR norms provided as with total calorie requirements which have been subsequently converted into food equivalents. The tables indicate that production of rice is in excess of the requirement as well as the effective demand (as depicted by regression equation incorporating prices and income) in the districts of Chengalput, North Arcot, South Arcot and Tanjavur. The tables indicate that the effective demand is likely to increase at a faster rate than the likely production, at the aggregate level for the State. Thus, the gap between the requirement and production as well as between production and effective demand is likely to increase, if special steps are not taken.

The rice gap would be maximum

In the case of Nilgiri and Dharmapuri district, for at least another five years. The situation in respect of Salem, Coimbatore, Madurai, and Tiruchirapalli indicate considerable deficits in the case of rice and pules. Barring year-to-year

fluctuations influenced mainly by changes in rainfall, on the whole, the projections given in the tables about food gaps are likely to be relevant and provide the minimum gaps rather than maximum gaps, since the production has been slightly over-estimated (because of the extrapolation based on trend method). The food gaps in respect of pulses are generally considerable in most of the districts, except Tirunelveii. Given the production pattern, Tanjavur and Coimbatore contrast in terms of surplus production of rice, and deficit production of sugar in the case of the former and reverse incase of the latter. It is difficult and not desirable to prescribe desirable cropping patterns based on the tables indicating food gaps since a number of factor, including agronomic, hydrological, geological and related features in addition to economic factors are important in order to arrive at desirable cropping pattern in each of tho districts. Such an exercise would be useful to facilitate proper planning of food balances at the district and State level.[6]

We realise that the food gap estimates are likely to be overestimate wherever the sign is negative (that is, in the case of relatively surplus districts) for specific commodities, and underestimate (positive) gaps in the case of most after districts due to possible tapering off of the growth rate in irrigated agriculture. We did not make adjustments at the district-level for this phenomenon, due to significant differentials in not anticipated growth rates across districts (although this exercise is not altogether beyond comprehension).

We could, however, make use of the adjusted estimates for the State as aggregate. The aggregate of estimates of district-wise gaps given in Table 19 and indicates relatively

---

6. It was originally envisaged that the IMM Ahmedabad, study on Production Sub-System would throw light on cropping planning but the report could not be utilised by his due to various paucities in information requirements and linkage with the overall integrated models.

less gaps for rice and cereals, compared to the estimates given in Table 1. This is anticipated from the basis of arriving at these estimates. For the purposes of operational interpretation it may be stated that these gaps are likely to constitute a set of lower limits of anticipated food gaps : the realistic estimates would be higher. In other words, the State should be prepared for meeting at least these gaps as a minimum requirement if the prices and economy as well as nutrition standards are to be enhanced.

The expected range of food gaps (defined as gap between normative requirements and likely production) may be summarised, for the purpose of evolving pragmatic intervention strategies affecting demand and supply, as under ;

In the year 1986–87, the ranges of percentage gaps in the case of rice, cereals, and grams and pulses wouln be 6.7 to 13.7, 10.4 to 11.1, 33.7 to 54.7, respectively ; the corresponding quantities in thousands of tonnes would range from 445 to 930, 962 to 1,036 and 182 to 297. From these estimates it appears likely that it would be realistic to except a shortfall of about 10 per cent in respect of cereals pooled together, if meeting on time to nutrition requirements at the aggregate level for the State as a whole is the objective in the case of pulses is likely to be of very high order ; the Sixth Plan of Tamil Nadu indicates but high priority is being accorded to higher production of pulses, although a simultaneous marginal change in food habits is likely to be the desirable approach for bridging the gap.

In the next section, we deal with alternative estimates of demand for main foods and corresponding gaps ; demand in this case affected bv prices and incomes.

TABLE 5 : Normative Demand For Food (Desee on Calorie)

(000' Tonnes)

Commodity	1979-80	1980-81	1981-82	1982--83	1983-84	1984-85	1895-86	1986-87
Rice	6102.3	6070.3	6191.7	6313.6	6435.2	6569.7	6670.9	6801.3
All cereals	8336.5	8292.8	8458.6	8625.2	8791.2	8975.0	9113.2	9291.0
Grams & pulses	486.4	483.8	493.5	503.2	512.9	523.6	531.7	542.0
Vegetables	1002.0	996.8	1016.7	1036.7	1056.6	1078.6	1095.4	1116.7
Fruits	2602.0	2588.2	2640.0	2692.0	2743.8	2801.2	284.03	2899.0
Milk	1355.2	1348.1	1375.1	1402.2	1429.1	1459·0	1481.5	1510.4
Srarchy foods	892.8	888.1	905.8	923.7	941.5	961.1	975.9	995.0
Sugar	1061.7	1056.1	1077.2	1098.4	1119.9	1142.9	1160.6	1183.2
Fish	426.3	424.0	432.5	441.0	449.5	458.9	466.0	475.1

TABLE 6 :—District-Wise Food Gaps Between Requirements and Production
(CHINGLEPUT)

(000' Tonnes)

Commodity	1981-82	1982-83	1983-84	1884-95	1985-86	1986-87
Rice	-372.2	-393.9	-415.5	-436.0	-458.1	-473.4
	(-82.3)	(-85.6)	(-88.5)	(-90.9)	(93.8)	(-94.1)
Careals	-261.0	-280.8	-300.6	-318.9	-339.1	-350.1
	(-42.3)	(-44.6)	(-46.8)	(-48.6)	(-50.8)	(-50.9)
Pulses	33.7	34.4	35.0	35.7	36.4	37,6
	(93.6)	(93.6)	(93.6)	(93.6)	(93.6)	(93.7)
Starchy foods	47,6	48.1	48.6	49.3	49.7	51.1
	(72.0)	(71.4)	(70.7)	70.2)	(69.6)	(69.4)
Sugar	-361.7	-383.4	-405.3	-427.0	-448.8	-469.5
	(-460.1)	(-478.0)	(-496.1)	(-512,0)	(-528.6)	(-535.9)
Fruits	96.5	95.6	94.6	94.3	93.2	94.9
	(50.1)	(48.6)	(47.2)	(46.1)	(44.8)	(44.2)

Figures in brackets are percentage of gap to requirement

TABLE 7 : District-wise food gaps between requirements and production
(North Arcot)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	—188.6	—210.5	—226.5	—241.2	—257.6	—308.4
	(—34.6)	(—38.3)	(—40.5)	(—42.2)	(—44.3)	(—55.3)
Cereals	—105.6	—127.5	—141.0	—153.0	—167.2	—228.6
	(—14.2)	(—16.9)	(—18.4)	(—19.6)	(—21.0)	(—30.0)
Pulses	10.51	8.7	7.25	5.92	4.5	0.4
	(24.2)	(19.8)	(16.2)	(13.0)	(9,7)	(0.8)
Staachy foods	70.0	69.9	70.8	71.8	72.7	68.4
	(87.8)	(87.0)	(86.5)	(85.9)	(85.4)	(83.9)
Sugar	—272.6	—285.9	—298.3	—310.5	—323.0	—341.4
	(—287.5)	(—299.1)	(—306.3)	(—312.4)	(—319.5)	(—352.3)
Fruits	43.8	32.7	24.1	15.1	7.2	—16.1
	(18.8)	(13.9)	(10.1)	(6.6)	(2.9)	(—6.8)

Figures in brackets are percentages ef gaps to requirements

TABLE 8: District-wise food gaps between requirements and production
(South Arcot)

(000' tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	—295.3	—304.3	—313.3	—327.8	—337.4	—347.1
	(—56.1)	(—56.7)	(—57.3)	(—59.4)	(—60.1)	(—60.7)
Cereals	—345.7	—359.0	—372.5	—393.4	—407.7	—421.9
	(—48.0)	(—48.9)	(—49.8)	(—52.2)	(—53.1)	(—54.0)
Pulses	32.3	32.9	33.5	33.7	34.2	34.7
	(77.0)	(76.9)	(76.8)	(76.6)	(76.4)	(76.3)
Starchy food	—127.3	—141.4	—155.4	—170.2	—184.3	—198.4
	(—165.3)	(—180.1)	(—194.2)	(—210.9)	(—224.5)	(—237.3)
Sugar	—292.1	—304.3	—316.6	—329.7	—342.1	—354.4
	(—318.9)	(—325.8)	(—332.9)	(—343.5)	(—350.1)	(—356.5)
Fruits	181.1	183.4	184.8	184.1	185.4	186.6
	(81.0)	(80.1)	(79.3)	(78.3)	(77.4)	(76.6)

Figures in brackets are percentage of gaps to requirements

TABLE 9 : District-wise food gaps between requirements and production
(Dharamapuri)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	206.1 (75.7)	210.5 (75.7)	214.7 (75.8)	219.4 (75.9)	229.9 (73.4)	239.5 (76.9)
Cereals	89.4 (24.0)	90.2 (23.8)	91.1 (23.5)	92.7 (23.5)	102.2 (24.9)	110.4 (25.9)
Pulses	—1.8 (—8.5)	—1.6 (—7.1)	—1.2 (—5.3)	—0.9 (—3.9)	—0.13 (—0.5)	—0.65 (—2.6)
Starchy foods	—36.7 (—92.1)	—40.6 (—99.4)	—44.0 (—108.2)	—48.8 (—115.4)	—51,99 (—118.1)	—55.3 (—121.4)
Sugar	—88.4 (—186.5)	—95.0 (—196.7)	—101.0 (—206.0)	—108.1 (—214.1)	—113.6 (—217.2)	—119.2 (—220.0)
Fruits	—36.7 (—31.6)	—34.4 (—29.0)	—32.1 (—26.6)	—29.7 (—24.1)	—24.6 (—19.2)	—20.1 (—15.2)

Figures in brackets are percentage of gaps to requirements.

TABLE 10 District-wise Food Gaps Between Requirements and Production (SALEM)

(000' tonnes)

Commodity	1982—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	324.4	333.6	342.5	352.8	361.5	377.1
	(69.8)	(70.4)	(71.0)	(71.6)	(72.1)	(72.9)
Cereals	361.0	367.5	397.7	393.8	405.6	426.8
	(56.9)	(56.8)	(57.6)	(58.5)	(59.2)	(60 5.)
Pulses	18.9	18.5	18.3	18.0	17.6	17.9
	(51.0)	(49.2)	(47.5)	(45.9)	(44.2)	(43.4)
Starchy Foods	—932.7	—991.9	—1051.2	—1110.4	—1169.8	—1228.1
	(—1373.7)	(—1431.3)	(—1488.9)	(—1540.1)	(—1595.9)	—1624.5
Sugar	—122.1	—130.9	—139.7	—148.3	—157.1	—164.8
	(—151.2)	(—158.8)	(—166.5)	(—173.0)	(—180.2)	(—183.3)
Fruits	152.0	146.7	150.4	154.5	158.0	164.4
	(76.8)	(72.7)	(73.1)	(73.5)	(73.9)	(74.6)

Figures in brackets are percentage of gap to requirement

TABLE 11 : District-wise food gap between requirement and production
(COIMBATTORE)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	478.7	489.1	499.6	511,3	521.2	530.9
	(72.9)	(73.1)	(93.2)	(73.4)	(73.5)	(73.7)
Cereals	443.6	454.7	465.	478.3)	488.3	498.2
	(59.5)	(49.7)	(49.9)	(50.3)	(50.4)	(50.6)
Pulses	17.8	17.9	18.1	18.4	18.4	18.5
	(34.1)	(33.6)	(33.3)	(32.1)	(32.6)	(32.3)
Starchy foods	62.9	17.9	181.1	18.4	18.4	18.5
	(65.5)	(63.6)	(61.7)	(59.9)	(58.2)	(56.4)
Sugar	—312.4	—322.4	—332.2	—342.0	—351.9	—362.0
	(—273.5)	(—276.9)	(—279.9)	(—282.4)	(—285.5)	(—88.7)
Fruits	173.9	171.8	169.7	168.3	165.9	163.5
	(62.1)	(60.2)	(58.4)	(66.7)	(54.9)	(53.2)

Figures in brackets are percentage of gap to requirements,

TABLE 12 :—District-Wise Food Gaps Between Requirements and Production
(NILGIRIS)

(000' Tonnes)

Commodity	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	60.4 (88.7)	74.1 (90.3)	75.5 (90.2)	76.9 (90.8)	78.1 (89.9)	79.3 (89.7)
Cereals	82.5 (88.7)	101.3 (90.4)	103.2 (90.3)	105.3 (90.2)	107.0 (90.1)	108.8 (90.1)
Pulses	5.3 (97.6)	6.4 (98.0)	6.6 (98.0)	6.7 (98.0)	6.8 (98.1)	6.9 (98.1)
Starchy foods	—79.8 (—805.7)	—78.9 (—658.2)	—80.1 (—656.6)	—81.1 (—649.0)	—82.2 (—647.6)	—83.4 (—646.3)
Fruits	25.63 (88.1)	32.1 (71.6)	33.3 (93.3)	34.6 (94.4)	35.8 (96.4)	37.0 (97.9)

Figures in brackets are percentage of gap to requirement

TABLE 13: District-wise food gaps between requirements and production
(MADURAI)

(000' tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	286.6 (48.7)	293.9 (59.7)	299.5 (49.8)	322.3 (51.6)	333.3 (52.5)	337.4 (52.8)
Cereals	287.4 (35.7)	300.0 (36.9)	304.9 (37.1)	335.8 (39.4)	350.7 (40.4)	356.2 (40.8)
Pulses	29.3 (62.5)	29.4 (61.5)	28.7 (59.8)	29.7 (59.7)	29.7 (58.8)	29.3 (57.5)
Starchy foods	6.3 (7.3)	3.0 (3.4)	—1.7 (—1.9)	—3.1 (—3.4)	—6.4 (—6.9)	—10.7 (—11·4)
Sugar	9.1 (8.9)	8.9 (8.5)	6.8 (6.5)	8.4 (7.8)	8.0 (7.2)	6.4 (5.7)
Fruits	—184.1 (—73.3)	—179.2 (—70.0)	—178.6 (—69.5)	—168.9 (—63.3)	—164.3 (—60.6)	—162.4 (—59.5)

Figures in brackets are percentages of gaps to requirements

TABLE 14 : District-wise Food Gaps between Requirement and Production
(Trichurapally)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	243.8 (43.0)	239.8 (42.8)	262.5 (45.3)	277.4 (46.9)	290.8 (48.3)	297.5 49.1)
Cereals	243.6 (31.5)	252.9 (32.5)	271.3 (34.3)	293.0 (36.2)	312.4 (38.0)	322.6 (39.0)
Pulses	30.4 (67.3)	30.4 (52.4)	30.9 (66.9)	31.5 (66.9)	32.0 (66.9)	32.2 (66.6)
Starchy Foods	24.9 (30.1)	21.7 (26.0)	19.4 (22.9)	17.6 (20.3)	15.4 (17.5)	12.3 (13.9)
Sugar	—25.7 (—26.1)	—23.8 (—24.0)	—20.8 (20.6)	17.2 (16.7)	—13.9 (—13.4)	—12.0 (—11.4)
Fruits	—166.5 (—68.8)	—182.5 (—74.9)	—195.3) (—78.9)	—207.2 (—82.1)	—219.9 (—85.6)	235.4 (—91.1)

Figures in brackets are percentage of gaps to requirements

TABLE 15 District-wise food gaps between requirements and production (Tanjavur)

(000' tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	—583.5 (—104.7)	—585.7 (—104.2)	—581.8 (—101.6)	—576.6 (—98.6)	—573.3 (—96.3)	—576.5 (—96.3)
Cereals	—384.1 (—50.4)	—383.5 (—49.9)	—374.5 (—47.8)	—363.8 (—45.5)	—364.5 (—42.2)	—356.5 (—43.6)
Pulses	12.5 (28.2)	12.8 (28.5)	13.5 (29.6)	14.1 (30.2)	14.9 (31.4)	15.0 (31.5)
Starchy foods	61.7 (75.7)	60.9 (74.1)	61.1 (72.9)	61.3 (71.7)	61.4 (70.5)	60.5 (69.0)
Sugar	15.3 (15.8)	13.6 (13.8)	10.6 (10.7)	12.4 (12.2)	11.7 (11.3)	9.7 (9.4)
Fruits	134.6 (56.6)	136.7 (57.0)	141.4 (57.8)	146.5 (58.7)	151.0 (59.4)	152.5 (59·7)

(Figures in brackets are percentage of gaps tc requirements)

TABLE 16 : District-wise food gaps between requirements and production
(Tirunevelii)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	54.9 (11.8)	47.0 (10.1)	45.4 (9.5)	44.5 (9.2)	35.9 (7.3)	30.9 (6.3)
Cereals	99,6 (15.7)	93.5 (14.6)	95.6 (14.7)	99.2 (14.9)	91.7 (13.7)	89.9 (13.2)
Pulses	—32.1 (—86.9)	—36.5 (—97.9)	—41.6 (—109.6)	—44.3 (—114.2)	—48.9 (—125.7)	—53,1 (—134.9)
Starchy foods	43.68 (64.3)	42.5 (62.0)	42.1 (60.3)	41.7 (58.7)	40.3 (56.5)	39.4 (54.6)
Sugar	65.3 (80.0)	65.4 (80.5)	66.4 (80.2)	67.8 (80.1)	66.7 (79.6)	86.2 (79.4)
Fruits	6.8 (3.4)	3.1 (1.6)	2.0 (1.0)	1.2 (1.6)	—3.1 (—1.5)	—5.7 (—2.7)

Figures in brackets are percentages of gaps to requirements

TABLE 17 District-wise food gaps between requirements and production
(Ramanthapuram)

(000' tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	127.6 (29.8)	133.6 (30.7)	139.3 (31.4)	146.7 (32.4)	162.8 (33.0)	157.8 (33.6)
Cereals	171.6 (29.4)	181.3 (36.6)	190.5 (31.4)	201.9 (32.6)	211.1 (33.5)	220.1 (34.3)
Pulses	26.0 (76.3)	26.9 (76.0)	26.9 (75.9)	27.4 (75.8)	(27.8) (75.6)	(28.2) (75.4)
Starchy foods	40.7 (65.1)	41.6 (65.3)	42.4 (65.4)	43,5 (65.7)	44.1 (65.8)	45.3 (65.9)
Sugar	15.3 (20,6)	15.1 (19.9)	14.81 (19.1)	14.8 (18.8)	15,5 (18.0)	14.1 (17.3)
Fruits	139.1 (76,2)	142.5 (76.6)	145.4 (76.9)	149.8 (77.4)	152.9 (77.7)	156.3 (78.0)

Figures in brackets are percentages of gaps to requirements

TABLE 18 : Food Gaps between Requirements and Production

(Kanyakumari)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	84.4 (44.0)	88.2 (45.1)	92.1 (46.0)	96.2 (47.2)	99.8 (48.1)	110.2 (50.6)
Cereals	151.3 (57.7)	156.5 (58.5)	161.7 (59.3)	167.4 (60.2)	172.4 (60.9)	186.6 (62.8)
Pulses	13.4 (87.6)	13.6 (87.4)	13.9 (87.3)	14.1 (87.0)	14.3 (87.0)	15.2 (87.3)
Starchy foods	—174.4 (—620.6)	—177.8 (—621.5)	—181.0 (—619.9)	—184.3 (—618.4)	—187.6 (—619.3)	—190.0 (—597.5)
Fruits	22.8 (27.8)	24.5 (29.3)	26.1 (30.6)	27.8 (32.0)	29.4 (33.2)	126.7 (36.4)

Figures in brackets are percentages of gaps between requirements

TABLE 19 : Food Gaps Between Requirements and Production
(Aggregate of Districts)

('000 tonnes)

Commodity	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	427.1 (6.89)	419.5 (6.66)	434.0 (6.75)	466.0 (7.09)	476.4 (7.12)	455.3 (6.72)
Cereals	833.6 (9.85)	850.1 (9.86)	874.9 (9.97)	938.3 (10.45)	980.9 (10.73)	961.9 (10.39)
Pulses	196.2 (39.74)	193.3 (38.45)	189.8 (37.05)	190.0 (36.29)	187.2 (35.13)	182.2 (33.73)
Starchy foods	—993.1 (—109.60)	—1080.7 (—117.12)	—1168.2 (—124.32)	—1251.7 (—132.85)	—1338.2 (—141.11)	—1429.5 (—148.99)
Sugar	—1283.9 (—119.12)	—1352.9 (—123.21)	—1424.0 (—127.43)	—1451.2 (—126.97)	—1553.2 (—133.45)	—1603.9 (—136.06)
Fruits	663.0 (25.09)	641.8 (23.85)	630.0 (22.99)	561.4 (20.03)	566.9 (19.86)	652.1 (22.56)

Figures in brackets are percentages of food gaps to requirements.

6

Nutrition Scenarios for Tamil Nadu

The purposes of this section are to : (i) estimate (market- generated/ effective) the demand for food items under varying levels of the main influencing parameters. namely, prices and income; and (ii) estimate the corresponding gaps between: (a) demand and production: (b) demand and requirements. Tables 21 and 22 depict the estimates of demand corresponding to plausible situations governing price and income levels. As expected, the estimates, by their very nature, approximate the demand at the aggregate level and presume that there would not be any major socio-economic transformations leading to unusual pattern of income and asset redistribution across the different segments of the population in Tamil Nadu.

Table 20 indicates projections of explanatory variables which are subsequently plugged in the State- level aggregate demand equation, leading to corresponding estimates of demand presented in Tables 21 and 22. In addition, two other alternative scenarios are generated (columns 3 and 4) which depict the impact of changes in prices and /or income. The range of variation across alternatives is of the order of 9 lakh tonnes in 1986-87 in the case of cereals/rice.

TABLE 20 : Estimates of Income aud Prices

Year	State domastic product (Rs. Crores)	Wholesale prices of ceresls (Rs. /Quintal)	Wholesale prices of rice (Rs./Quintal)
1981-82	5722	230.29	248.51
1982-83	6007	241.49	260.58
1983-84	6293	252.59	272.65
1984-85	6578	263.69	284.72
1985-86	6863	274.79	296.79
1986-87	7148	285.89	308.86

Trend equation for prices of cereals :

$$P_t = 52.79 + \underset{(4.77)}{11.1\,t}; \quad R^2 = 0.62$$

Trend equation for income :

$$Y_t = 1157.28 + \underset{(15.52)}{285.29\,t}; \quad R^2 = 0.96$$

Trend equation for prices of rice :

$$P_t \quad 55.39 + \underset{(4.69)}{12.07\,t}; \quad R^2 = 0.61$$

Where P_t = Wholesale prices of cereals in year t

Y_t = State domestic product in year t

P_t = Wholesale prices of rice in year t

TABLE 21 : Demand for Cereals : Projections with Different Alternatives ('000 tonnes)

Year	Alternative* I	Alternative II	Alternative III
1981-82	8086.50	7777.30	8491.71
1982-83	8293.39	7969.29	8720.05
1983-84	8501.78	8162.79	8948.68
1984-85	8708.66	8354.79	9176.71
1985-86	8915.87	8547.09	9404.15
1986-87	9123.07	8739.39	9632.48

This table is based on the regression equation

$$C_t = 4030.59 - \underset{(2.44)}{13.42}\, P_t + \underset{(4.9)}{30.63}\, Y_t \; ; \; \bar{R}^2 = 0.69$$

Where C_t = demand for rice year t

P_t = wholesale prices of cereals in year t

Y_t = index for state domestic product at current prices (1970-71 = 100).

*Alternative I : P_t and Y_t substituted in the equation are projections

Alternative II : Demand when P_t is increased by 10% over trend and Y_t is trend projection

Alternative III : Demand when P_t and Y_t are increased by 10% over trend projections.

TABLE 22 : Demand for Rice : Projections with Different Alternatives ('000 tonnes)

Year	Alternative* I	Alternative II	Alternative III
1981-82	7385.68	7018.65	7751.45
1982-83	7573.44	7187.36	7956.81
1983-84	7760.39	7357.76	8163.85
1984-85	7946.98	7526.48	8368.89
1985-86	8183.88	7695.51	8574.56
1986-87	8320.78	7864.53	8779.92

This table is based on the regression equation :

$$C_t = 3727.54 - \underset{(2.56)}{14.77\ P_t} + \underset{(4.79)}{30.79\ Y_t} \ ; \ \bar{R}^2 = 0.68$$

Where C_t = demand for rice in year t

P_t = Wholesale prices of rice in yeer t

Y_t = Index for state domestic product at current prices (1970-71 = 100)

*Alternative I : P_t and Y_t substituted in the equation are projections

Alternative II : Demand when P_t is increased by 10% over trend and Y_t is trend projection

Alternative III : Demand when P_t and Y_t are increased by 10% over trend projections

The demand projections given in these tables are likely to correspond to realistic alternative economic situations. However, for the purpose of assessing the possible impact of rather less plausible situations governing prices and incomes, the demand estimates have been obtained which are summarised in the subsequent paras.

The demand for all cereals and rice are projected using different alternatives. A 10 per cent fluctuation on either side for prices and income is assumed and the resultant demand is projected with the possible combinations using multiple regression equations. Out of the $3^2 = 9$ combinations, that is, three cases for prices (trend, 10 percent increase over trend, and 10 per cent decrease over trend), and three cases for income (trend 10 per cent increase over trend, and 10 per cent decrease over trend), three are presented in the table which are found feasible. The rest six alternatives are explained below.

(i) In this case, it is assumed that prices will remain as per trend and income will increase by 10 per cent over the trend projections. The corresponding demand projections for the first and the last year, that is, 1981-82 and 1986-87, are respectively, 8800.88 and 10016.13 thousand tonnes for all cereals and 8118.18 and 9236.47 thousand tonnes for rice.

(ii) Here, the prices will remain as per trend, and the income is decreased by 10 per cent over the trend projections. In 1981-82, the demand is found to be 7372.05 and 6653.19 thousand tonnes for cereals and rice, respectively, and 8229.64 and 7404.77 thousand tonnes in each of the above cases for the year 1986-87.

(iii) Under this alternative it is assumed that prices will go down by 10 per cent and income will remain according to the trend. The demand in this case is

found to be 8395.69 and 7752.72 thousand tonnes in 1981-82 and 9506.74 and 8777.02 thousand tonnes in 1986-87 for cereals and rice, respectively.

(iv) This alternative is based on the assumption that prices will go up by 10 per cent and income will decrease by 10 per cent. The corresponding demand estimates are 7062.89 and 6285.85 thousand tonnes for the year 1981-82 and 7845.99, and 6949.14 for the year 1986-87 for cereals and rice, respectively.

(v) In this case, the demand is projected assuming that prices will go down by 10 per cent and the income will raise by 10 per cent. For cereals and rice the corresponding demands are found to be 9110.11 and 8485.52 for 1981-82, and 10[illegible]99.84 and 9692.41 for 1986-87, respectively.

(vi) Here, it is assumed that the prices and income will decrease by 10 per cent and the corresponding demand projections for cereals and rice, respectively, are 7681.28 and 7019.91 for 1981-82 and 8613.35 and 7861.63 for 1986-87.

Comparisons of estimated demand furnished in Tables 21 and 22 with projected production estimates indicate that the percentage gaps between market determined demand and likely production would be of the range 7.5 to 9.5 per cent in the case of cereals during the period 1982-83 to 1986-87 for the State as a whole. The corresponding gaps for rice appear to be much higher, mainly because the estimates of production are not based on trend but adjusted for possible lower growth rate in contrast to other food commodities. Also, it is likely that the market determined demand for rice could be higher than is required based simply on nutrition norms. However, the estimated gaps in case of cereals is likely to be of greater relevance as it would account for possible over estimates of non-rice cereal commodities and possible under estimates of rice as far as production is concerned.

7

Concluding Remarks

1. The intervention strategies should aim at an integrated approach affecting both produce system and consumer system at macro and micro-levels of each system. The intervention should be so optimally designed to bring about an economic and behavioural rapprochement between the desired and the existing socio-economic objectives. The analysis for designing the intervention can better be done by examining the decision-making process of different units in their production and consumption behaviour under differing sets of available alternatives and information associated with the decision-making processes.

It is advisable to isolate the intervention programmes, which, in a sense, are indivisible with respect to individuals, such as nutrition education, sanitation and preventive medicines, natural betterment of diseases resistance by improving quality of water, etc. The programmes should be designed by using the cost-effectiveness analysis.

It is possible to formulate a comprehensive model to arrive at optimal nutrition intervention policies. This could be accomplished in the following manner: Formulate an input–output frame in respect of each possible intervention sub-system, for instance, school feeding, processing of foods, etc. when inputs are in terms of economic parameters like prices of commodities, and other inputs (like labour, etc.) and outputs are (linear) functions of the resultant nutrient gain (in respect of different nutrients) in terms of, say, some

of the anthropometric features. Once this frame is arrived at, the optimisation models incorporating least cost objective or maximisation of parameters of nutrition status as an objective, subject to the input–output relations and other relevant constraints can be formulated. However, it is difficult to obtain the input–output relations using the existing knowledge. Hence, the need for formulating models which can reasonably approximate the above type of general model.

2. The controversy on the specified minimum nutrition requirements and suggestions regarding change made by researchers like Sukhatme, and the continued inconclusive debate should be put into a policy perspective other than statistical perspective although the latter would be relevant. The major issues to be clarified before referring to minimum nutrition requirements are: what are the functional objectives of the specified minimum requirements? Are they simply to preserve the physiological structure and allow functions of the body and mind or do they hinder some desired physiological and psychological developments which would otherwise not take place by status-quo ante approach of nutrition requirements? Also, the time horizon within which any catch–up growth is aimed at in the case of children makes difference in the specification of nutrition requirements. In any case, depending upon the sample size, coverage of population and, overtime, the estimates of average nutrition requirements are bound to vary rather significantly. Thus, in a population with widespread malnutrition the main issue should be to prioritise the most needy groups of population in terms of age-groups, socio-economic groups, geographic location, and time periods for possible support (directly or indirectly with government assistance) and to implement various programmes in a co-ordinated manner. Thus, the urgent requirement is not simply an estimate of poverty but eradication of high order undernourishment which has short-term and long-term implications on physiological, and economic development. The limited set of resources available

at the national and State levels need not accrue to the popution with doubtful undernourishment.

(3a) The need for micro-planning for nutrition development based on local production of food commodities and local requirements of foods and specific nutrient gaps in each region should be experimented at the earliest occasion, on a pilot basis, so that some of the impediments in implementing programmes evolved on an all-india basis can be nullified, and also possibly the cost of administrating the various programmes brought down. Here again, decentralisation of planning and implementation should be accompained by vigorous efforts in respect of co-ordination, monitoring and evaluation— a task of the higher level authorities.

(b) Considerable further investigations are needed on the topics suggested in the Report.

4. Specific studies pertaining to Tamil Nadu deal with analysis of trends in food and nutrient consumption along with determinants of nutrition intake and child illness. Some of the findings lead to policy recommendation on programmes for policy implementation. Projections of behavioural demand for food and those of physiologically required food equivalents of nutrients enable us to estimate the magnitude and type of food gaps likely to prevail in the next few years, after comparative analysis with estimated food production for the next few years. Similar exercises, when carried out for each State, will be useful for evolving a number of integrated policy intervention programmes.

5. The political will and the administrative commitment to achieve improved results—results not based on expenditure statistics or resource allocation indicators, but based on factual information relating to the type and magnitude of nutrition benefits (whether based on clinical, anthropometric status)— or as a next approximation, to improved intake of nutrients by target groups.

6. Proper composition should be ensured of the Co-ordination Committee representing various departments/agencies involved in policy formulation and implementation of Schemes which have direct and indirect bearing on nutrition status of target groups; this would also include the proper selection of the Chairman of the Committee, mainly based on his status in the government so that the Chairman can effectively contral various activities and give directives to various departments and other agencies.

7. Information-base for decision-making is an important consideration for the effective functioning of the co-ordination activities. The availability of dependable and timely data based on various surveys, monitoring and evaluation activities on time; this includes evolving feedback information systems for proper planning and implementation, and timely action for corrective measures.

8. The frequency of meeting should be need-based, that is, depeneing upon the type and intensity of different activities and seasonality, the meetings should be held; we feel that quarterly meeting is a must for any effective co-ordination.

Among the conclusions arrived at in the process of analysis carried out in the Supplementary Report are:

(i) The functions of Food and Nutrition Board can be more effectively operationalised with the strengthening of expertise and the necessary staff. Although the description of the functions of the Central Coordination Committee provides wide scope for integration of various activities, the information-base for decision-making must be strengthened by creating a monitoring and evaluation cell. At the State level; monitoring and evaluation cells may have to be created to deal with

operational aspects, including the implemtation and effectiveness of different programmes.

(ii) There is an urgent need for the survillance of poverty, and periodic quantitative assessment of type and degree of malnourishment/poverty. The institutional arrangements may have to be made to accomplish this task.

(iii) A high-power National Committee on Nutrition is needed, with the Prime Minister as Chairman and all Secretaries of all economic ministries/Departments, and those dealing with different nutrition programmes, as members so as to ensure the effective co-ordination. Alternatively, the National Children's Board (formed in 1974) can take more effective steps in co-ordinating the programmes in respect of children forming the main thrust of the activities; however, this would require strengthening of the Board with skilled manpower and organising a relevant data-base system to enable effective decision-making. Constituting a sub-committee, which can serve as Standing Committee of this National Committee, would be useful so that it can meet at desirsble frequencies.

9. In the case of Tamil Nadu, in the year 1986–87 the ranges of percentage gaps in respect of rice, cereals, and grams and pulses would be 6.7 to 13.7, 10.4 to 11.1 and 33.7 to 54.7, respectively; the corresponding quantities would range from 455,000 to 930,000, 962,000 to 1036,000, and 182.000 to 297,000 tonnes. From these estimates, it appears likely that it would be realistic to expect a shortfall of about 10 per cent in respect of cereals pooled together, if meeting the nutrition requirements at the aggregate level for the State as a whole is the objective. The expected shortfall under this objective in the case of pulses is likely to be very

high; the Sixth-Plan of Tamil Nadu indicates that high priority is being accorded to increase the production of pulses. However, we consider that a simultaneous marginal change in food habits would be the desirable and an effective approach towards bridging the gap.

10. The percentage gaps between market determined demand and the likely production would be of the order of 7.5 to 9.5 per cent, in the case of cereals during the period 1982–83 to 1986–87 for Tamil Nadu as a whole.

ANNEXURE—1

Proportion of Nutrients Derived from Different Percapita Food Availability (Average for 1966–1976)

Commodity	g. per day	Calorie (K. Gal)	Protein (g.)	Iron (mg.)	Vit. A (I.U.)	Calcium (g.)
Cereals	47.53	62.60	62.02	73.91	4.19	30.55
Starchy foods	2.29	1.95	0.52	—	0.12	2.78
Sugar	8.15	10.30	0.40	17.39	6.59	8.33
Grams and Pulses	3.04	4.10	12.40	4.35	2.46	5.56
Spics and condiments	1.21	1.25	2.65	—	2.22	5.56
Nuts and seeds	1.35	2.20	1.94	—	0.06	2.78
Vegetables	5.54	0.75	1.82	4.35	3.89	2.78
Fruits	13.96	3.95	1.84	—	69.98	2.78
Meat	0.54	0.15	2.05	—	—	—
Eggs	0.16	0.10	0.38	—	1.50	—
Fish	2.69	0.65	6.26	—	—	2.78
Milk	11.21	3.95	7.72	—	8.99	38.89
Oils	2.80	8.05	—	—	—	—
Fat	0.02	—	—	—	—	—
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source : Food Balance Sheets TNNP, Office, Madras

ANNEXURE—2

Direct and Indirect Indicators of Nutrition and Health

I. Vital Statistics :

1. Birth rate
2. Death rate
3. Growth rate
4. General fertility rate
5. Net rural-urban migration rate
6. Percentage of urban population
7. Age specific mortality rates by sex :
   0-1 years 6-14 year 46 years and above
   1-5 years 15-45 years
8. Proportional mortality rate by age and sex:
   0-1 year 6-14 years 46 years and above
   1-5 years 15-45 years
9. Proportion of births by age of mothers :
   $<$ 18 years 19-25 years, 26-35 years, 35-45 years and above
10. Proportion of births by parity :
    $<$ 3, 4-6 and 7th parity and above
11. Proportional mortality by parity :
    $<$ 3, 4-6 and 7th parity and above
12. Sex ratio
13. Sex ratio by age :
    0-1 year, 1-5 years ; 6-14 years
    15-64 years ; and 65 years and above
14. Maternal mortality rate
15. Neonatal mortality rate by sex

16, Post-neonatal mortality rate by sex

17. Expectation of life by age and sex
Ages : at birth : 3rd year; 5th year, 45th year ; 55th year; and 65th year

18. Age specific mortality rate from infectious diseases like diarrhoea, measles, etc.

19. Wills-Waterloo index – Ratio of deaths in children of ages 1–4 years to that of infants aged 1–11 months.

II. Health and Nutrition

(A) Indi cators of dietary adequacies :
Family diets and dietaries of vulnerable groups by ages/Nutrients

1. Percaput daily intake of calories

2. Percaput daily intake of total protein

3. Percaput daily intake of animal protein

4. Percaput daily intake of vitamin A

5. Percaput daily intake of vitamin B complex

6. Percaput daily intake of vitamin C

7. Percaput daily intake of Iron

8. Percaput daily intake of calcium

9. Percentage of families with aggregate calorie intake below the recommended allowances

10. Percentage of families with aggregate protein intake below the recommended allowances

11. Percentage of families with aggregate calorie intakes and protein intakes below the recommended allowances

12. Percentage of families with aggregate calorie intakes and protein intakes above the recommended allowances

13. Percentage of families with aggregate calorie intake below the recommended allowances and protein intake above the recommended allowances.

14. Percentage of families with aggregate calorie intake above the recommended allowances and protein intake below the recommended allowances

Dietaries :

Percaput intake of foodstuffs :

1. Cereals and millets
2. Pulses and legumes
3. Milk and milk products
4. Flesh foods : Fish, meat and eggs
5. Vegetables : leafy, roots and tubers and others
6. Oils and fats
7. Condiments

(B) Food Balance Sheets :

1. Percaput food available for consumption by item of foodstuffs
2. Percaput calorie content of national food supplies
3. Percaput total protein contents of national food supplies
4. Percapnt animal protein content of national food supplies
5. Percaput fat content of national food supplies

(C) Prevalence of clinical forms of malnutrition :

i) Percentage prevalence of nutrition deficiency signs by sex, age, socio-economic status

ii) Percentage prevalence of nutrition deficiency signs by parity and sex in 0-5 year age group children

iii) Percentage prevalance of nutrition deficiency signs by gravida in women of child bearing age

iv) Percentage prevalance of water borne diseases by age and sex

(D) Indicators of Growth and Development :

i) Mean, SD & CV values of height (cm), weight (kg), arm circumference (cm) and fat fold at triceps (mm) by age, sex and socio-economic status,

ii) Percentile values of height (cm), weight (kg), arm circumference (cm) and fat fold at triceps (mm) by age, sex, and socio-economic status. Percentiles 3rd, 25th, 50th, 75th and 97th

iii) percentage of population by various grades of malnutrition (Jelliffe classification)

iv) Percentage prevalence of normal and chronic current and current forms of undernutrition in preschool children

v) percentage of preschool children with weight/height index less than 1,35; 1.35-1.50; 1.80-1.65 and 1.65 and above

vi) percentage prevalence of overweight and obesity by age, sex and socio-economic status.

III. Hospital Nutrition Statistics

1. percentage of 0-5 years' children admitted with mild or severe forms of malnutrition

2. percentage of O-5 years' children attending hospital with specific signs of malnutrition

3. percentage of hospital beds taken over by children of O-5 years age with severe forms of clinical protein calorie-malnutrition. anaemia, Vitamin A and B complex deficiencies

4. Mean, S D & C V Values of height and weight measurements of pre-school children admitted for treatment-intial : Final (at discharge)

5. Mean and S D values for duration of treatment (in days) by specific forms of malnutrition

6. Number of hospital beds per 10,000; population

7. Number of days treated as percentage of total days of sickness by age, sex and social classes

8. Medical expenditure per day per patient treated in the hospital : Inpatient and out-patient

9. Number of patients per day per medical or dental doctor or per medical personnel

10. Percentage of newborns with birth weight below 2.5 kg by socio-economic status and sex.

11. Percentage of new borns with birth weight below 2.5 kg by parity (<3 and 4 or more and Primpara and multipara)

12. Percentage of pregnant women with haemoglobin levels below or equal to 10 g / 100 ml by age and order of pregnancy

13. Foetal deaths rate and neonatal death rates per 1000 hospital deliveries by socio-economic classes

14. Prevalence of tuberculosis in undernourished hospital admitted population by broad age groups and sex

IV. Housing and Environment

1. Percentage of households without homes
2. Percentage of households in permanent or semi-permanent dwellings
3. Percentage of households with access to safe drinking water or piped water service
4. Percentage of households using electricity for domestic purpose
5. Percentage of households with more than two persons per room
6. Percentage of households in densly populated areas
7. Percentage population living in areas with sewerage system (or service)
8. Percentage of population living in houses which do not require repair
9. Number of telephones per 10,000 population

V. Income and Consumption Expenditures

1. Percapita available income per household at constant and current prices
2. Percapita household consumption expenditure at constant and current prices
3. Percentage of household consumer expenditure on food by items of food intake
4. Twentyfifth percentile and 75th Percentile values of consumption expenditure on food as percentage of total consumption expenditure

5) Percapita expenditure on health and medical care

6. Percapita mean savings per household

VI. Other Indicators

1. Percentage of population who are literate by sex

2. Percentage of population with elementary school education by sex

3. Percentage of population with H.S.C. education by sex

4. Percentage of population with graduate degree or above by sex

5. Percentage of population owning cultivable land

6. Percentage of land owned by non-cultivators

7. Percentage of population - the top 5 per cent of land owners (arranged according to the size of land owned)

8. Doctor population ratio in rural areas; tribal areas and urban areas.

9. Hospital bed population ratio in rural areas, tribal areas and urban areas.

10. Average amount insured of life insuarance per household/person.

ANNEXURE 3

TABLE 1 : Production of Food Commodities Based on Trend Method
(Aggregate of Disrricts)

('000 tonnes)

	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	6194.3	6298.3	6424.2	6569.1	6689.8	6775.4
Cereals	8462.4	8618.2	8776.3	8974.6	9139.2	9256.2
Grams and Pulses	493.7	502.7	512.2	523.5	532.8	540.2
Starchy foods	906.1	922.7	939.7	942.2	948.3	959.4
Sugar	1077.8	1097.8	1117.5	1142.9	1163.9	1178.8
Fruits	2642,8	2691.4	2740.6	2803.0	2854.2	2890.9

TABLE 2 : Production of Food Commodities

(CHINGLEPUT)

('000 tonnes)

Commodity	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	824.2	854.7	885.1	915.6	946.1	976.6
All cereals	878.5	910.4	942.2	974.0	1005.8	1037.6
Pulses	2.29	2.34	2.39	2.44	2.49	2.54
Starchy foods	18.49	19.29	20.1	20.9	21.7	22.5
Sugar	440.3	463.6	487.0	510.4	533.7	557.1
Fruits	96.2	100.9	105.6	110.2	114.9	119.6

TABLE 3 : Production of Food Commodities
(North Arcot)

(000' tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	680.4	706.9	733.4	759.8	786.3	812.7	839.2	865.6
All cereals	793.9	821.9	849.9	877.9	905.8	933.8	961.8	989.8
Pulses	28.43	30.66	32.89	35.12	37.35	39.58	41.81	44.04
Starchy foods	8.31	9.00	9.69	10.38	11.06	11.75	12.44	13.13
Sugar	339.05	353.23	367.41	381.59	395.77	409.95	424.13	438.31
Fruits	162.37	175.42	188.47	201.52	214.57	227.62	240.67	253.72

TABLE 4 : Production South Arcot

(000' tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	782.84	802.19	821.54	840.89	860.24	879.59	898.94	918.29
Cereals	1009.53	1037.07	1064.61	1092.15	1119.69	1147.23	1174.77	1202.31
Pulses	9.16	9.39	9.62	9.85	10.08	10.31	10.54	10.77
Starchy foods	173.33	188.85	204.37	219.89	235.41	250.93	266.45	281.97
Sugar	355.66	369.68	383.70	397.72	411.74	425.76	439.78	453.80
Fruits	36.83	39.69	42.55	45.41	48.27	51.13	53.99	56.85

TABLE 5 : Production : Dharmapuri

(000' tonnes)

Commodity	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Rice	63.85	65.01	66.17	67.33	68.43	69.65	70.81	71.97
Cereals	269.69	276.19	282.69	239.19	295.69	302.19	308.69	315.19
Pulses	23.30	23.42	23.54	23.66	23.79	23.91	24.03	24.15
Starchy foods	66.71	71.59	76.47	81.35	86.23	91.11	95.99	100.97
Sugar	120.74	128.23	135.80	143.33	150.86	158.39	165.92	173.45
Fruits	152.68	152.72	152.76	152.80	152.84	152.88	152.92	152.95

TABLE 6 : Production : Salems

(000' tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	139.96	139.94	139.92	139.90	139.88	139.86	139.84	139.82
Cereals	279.31	279.31	279.30	279.30	279.29	279.29	279.28	279.28
Pulses	16.05	17.08	18.12	19.16	20.20	21.24	22.28	23.31
Starchy foods	879.43	940.04	1000.65	1061.26	1128.87	1182.48	1243.09	1303.70
Sugar	182.25	192.60	202.95	213.30	233.65	234.00	244.35	254.70
Fruits	54.48	54.68	45.88	55.08	55.28	55.48	55.68	55.89

TABLE 7 : Production : Coimbattore

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	172.77	175.21	177.63	180.09	182.53	184.97	187.41	189.85
Cereals	439.60	446.28	452.96	459.64	466.32	473.00	479.68	486.36
Pulses	32.72	33.60	34.48	35.36	36.24	37.12	38.00	38.88
Starchy foods	28.01	30.56	33.11	35.66	38.21	40.76	43.31	45.86
Sugar	402.26	414.43	426.60	438.77	450.94	463.11	475.28	487.45
Fruits	90.78	98.35	105.92	113.49	121.06	128.63	136.20	143.77

TABLE 8 Production : Nilgiris

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	7.10	7.38	7.66	7.94	8.22	8.50	8.78	9.06
Cereals	9.89	10.19	10.49	10.79	11.09	11.39	11.39	11.99
Pulses	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Starchy foods	87.03	88.35	89.67	90.99	92.31	93.63	94.95	96.27
Fruits	4.55	4.01	3.47	2.93	2.39	1.85	1.31	0.77

TABLE 9 : Production : Madurai

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	301.74	301.76	301.77	301.78	301.80	301.82	301.33	301.35
Cereals	515.85	516.03	516.21	516.39	516.57	516.75	516.93	517.11
Pulses	15.96	16.78	17.69	18.41	19.23	20.05	20.86	21.67
Starchy foods	70.04	74.92	79.80	84.68	89.56	94.44	99,32	104.20
Sugar	88.50	90.83	93.16	94.49	97.82	100.15	102.48	104.81
Fruits	435.23	435.27	435.31	435.35	435.39	435.43	435.47	434.50

TABLE 10 : Production : Tiruchirapally

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1935—86	1986—87
Rice	328.65	325.67	322.69	317.71	316.73	313.73	310.77	307.79
Cereals	540.69	535.49	530.29	525.09	519.39	514.69	509.49	504.29
Pulses	14.13	14.46	14.74	15.02	15.30	15.58	15.86	16.14
Starchy foods	50.65	54.31	57.97	61.63	65.29	63.95	72.61	76.27
Sugar	127.10	125.70	124.2	122.89	120.09	122.09	118.69	117.29
Fruits	374.14	391.26	408.38	425.50	442.62	459.74	476.86	493.98

TABLE 11 : Production : Tanjavur

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	1127.12	1133.96	1140.80	1147.64	1154.48	1161.32	1168.16	1175.00
Cereals	1133.92	1139.66	1145.40	1151.14	1156.88	1162.62	1168.36	1174.10
Pulses	31.54	31.71	31.87	32.03	32.19	32.36	32.52	32.68
Starchy foods	16.87	18.33	19.79	21.25	22.71	24.17	25.63	27.09
Sugar	76.65	79.18	81.71	84.24	86.77	89.30	91.83	94.36
Fruits	103.30	103.27	103.24	103.21	103.18	133.14	103.11	103.08

TABLE 12 Production : Tirunelveli

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	388.25	398.89	409.53	420.17	430.81	441.45	452.09	462.73
Cereals	514.68	524.73	534.78	544.83	554.88	564.93	574.98	585.03
Pulses	59.83	64.49	69.15	73.81	78.47	83.13	87.79	92.45
Starchy foods	20.80	22.51	24.22	25.93	27.64	29.35	31.06	32.77
Sugar	14.59	15.03	15.47	15.91	16.36	16.80	17.24	17.68
Fruits	181.33	186.35	191.37	196.39	201.41	206.43	211.45	216.47

TABLE 13 Production : Ramanathapuram

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	294.97	297.30	299.63	301.96	304.29	306.62	308.95	311.28
Cereals	408.45	410.23	412.01	413.79	415.57	417.35	418.13	420.91
Pulses	7.64	7.86	8.08	8.30	8.52	8.74	8.96	9.18
Starchy foods	21.11	21.44	21.77	22.10	22.43	22.76	23.09	23.42
Sugar	55.59	57.29	58.99	60.69	62.39	64.09	65.79	67.49
Fruits	42.98	43.14	43.30	43.46	43.62	43.78	43.94	44.10

TABLE 14 : Production : Kanyakumari

('000 tonnes)

Commodity	1979—80	1980—81	1981—82	1982—83	1983—84	1984—85	1985—86	1986—87
Rice	107.50	107.48	107.46	107.45	107.43	107.42	107.40	107.38
Cereals	111.00	110.95	110.90	110.85	110.80	110.75	110.70	110.65
Pulses	1.77	1.84	1.90	1.96	2.02	2.09	2.15	2.21
Starchy foods	194.79	198.65	202.51	206.37	210.23	214.09	217.95	221.81
Fruits	59.09	59.09	59.09	59.09	59.08	59.08	59.08	59.08

Co-ordination, Monitoring and Evaluation 4

1

Introduction

Integrated nutrition planning does imply planning as a comprehensive function incorporating co-ordination, monitoring, and evaluation. The Sixth Five Year Plan document indicates a lack of success in several of the nutrition programmes due mainly to ineffective monitoring and evaluation. It is, therefore, useful to review with some historical perspective the efforts and present state of affair in respect of co-ordination, monitoring, and evaluation of nutrition programmes. In the series of reports prepared under Tamil Nadu Nutrition Project by ASCI, Hyderabad, this report is aimed at analysing some of the features governing the implementation of programmes; primary data collection and field information gathering were, however, not taken up as part of this effort.

The analysis in this report is based mainly on secondary sources of information, especially various expert committee reports, Five-Year Plans, Evaluation Reports prepared by Tamil Nadu Government and other organisations, and special research monographs and related literature, in addition to a few discussions with senior officials.

In order to improve the planning and implementation features of nutrition programmes we need to examine certain organisational and operational aspects. As the need for proper co-ordination. monitoring and evaluation for

successful planning and execution of nutrition programmes is abundently clear, the relative roles of these factors have to be given their due recognition in the process of rational decision-making. Monitoring function generates information based on improved quality of decisions taken mainiy for effective implementation minimising costs and time. Evaluation of programme could lead to better future planning so as to optimise the scarce resources. Co-ordination can be deemed as a process of decision-making based on a set of guidelines and information based on monitoring and evaluation, the inrormation-base, however, is not only departmental monitoring reports but should be proper feed back from targetted beneficiary groups. The objectives of co-ordination may be taken as (1) optimal utilisation of limited resources, (2) proper sequencing and complementing of different inputs needed in each of the programmes, (3) finding solutions to procedural bottlenecks at lower levels. if any, and (4) appreciate common goals of all the programmes and relative roles of individual departments and individual schemes.

The value of information may be defined as the net gain in resources for attaining specific levels of nutrition develpment. The costs (direct and indirect) of co-ordination, montoring, and evaluation should, however, be recognised. In general it is time that the costs are much less, compared to benefits that can accrue as a result of these functions. The methods of co-ordination can however, vary significantly. Ideally, this task would be easier if the concerned departments, and administrative units, issue comprehensive, clear, and practicable guidelines soon after the launching of programmes.

The co-ordination effort would be very limited as it needs to confine only with the final results of implementation. However, often this is not possible due to several types of unforeseen bottlenecks. Accordingly, constant efforts are needed to ensure that the proposed

programmes deliver the planned benefits. A precondition for proper co-ordination is the supply of correct, and sharing of information; alternatively, if there are built-in behavioural characteristics to misreport information, the task of a co-ordinating body should be to recognise these elements and correct the system. Whether such a correction takes place by careful information intelligence or by periodic circulars and improvements and guidelines for implementation or via periodic meetings involving the concerned functionaries of different programmes and departments, the ultimate objective of co-ordination should not be lost sight of. Among the aforesaid alternatives, an ideal solution probably would be to evolve an optimal-mix of all the methods. However, general solutions to this problem are hard to find; only certain guiding principles can be evolved and the heads of administrative departments could take specific steps based on such guidelines. In the subsequent paragraphs, details of various types of committees proposed for co-ordination are given in order to examine the historical perspectives, but it should be clear that the committee method is only an approach for co-ordination and not necessarily the most efficient or the sufficient condition for successful implementation of the programmes.

This study briefly examines the co-ordination arrangements at the national and State (in respect of Tamil Nadu) levels, and explore possibilities of their improvemant. Since child nutrition is an area of utmost importance, the suggestions contained in various reports of expert committess have briefly been reviewed. In the subsequent sections the normative and practical aspects of monitoring and evaluation are discussed after an ananlysis of evaluation studies dealing with some of the nutrition programmes. possibilities of improved co-ordination, monitoring. and evalaution are also examined.

2

National and State Level Co-ordination

The first major attempt made at the national level for co-ordination in nutrition programmes was the setting up of the Food and Nutrition Board under the Departmet of Food in April 1964. The Board was set up to pay "exclusive attention to the various connected programmes in this field and draw up and implement programmes expedtiously and effectively." The functions of the Board were inter alia, to "work out policies and advise the government and undertake aid, promote and coordinate activities in regard to: (i) the development and popularisation of subsidiary and protective foods; (ii) nutrition, food extension and food managemment; (iii) the conservation and efficient utilisation as well as augmentation of food resources; (iv) food preservation, processing, packaging, transportation, and other technical aids; and (v) such other matters as the Board may consider necessary, incidental or conducive to the attainment of the above objects.

The Board's role is mainly advisory. The Secretary to the Department of Food is its Chairman. The members include Joint Secretary (Department of Food), Financial Adviser (Department of Food), Commissioners/Directors of Agriculture, CFTRI, Mysore, and NIN, Hyderabad, Director General CSIR, and other experts. The Board plans and implements several programmes, some of which are continued in collaboration with research institutes. However,

the functions of the Board did not envisage effective monitoring and evaluation of nutrition programmes except in the case of programmes directly under its supervision, Generelly, the Board met once in a year. There is considerable scope for enlarging the monitoring and evaluation functions of the Board so that it can play more effective role in guiding nutrition policies, in examining relative efficacies of different programmes as well as their cost-benefit implications, using the feedback information on monitoring and evalutlon. This would also call for strengthening of the machinery in order to obtain and analyse information.

Some of the other measures adopted for promoting co-ordination at different levels are summarised below.

The National Nutrition Advisory Committee was set up in 1964 under the Ministry of Health and Family Planning with the Union Health Minister as Chairmon and 41 members representing various departments and States. The main function of this Committee is to assist in the formulation of the national nutrition policy, to scrutinise various nutrition schemes and watch the progress of programme implementation. This Committee became defunct after three years of functioning.

An Advisory Committee for Special Nutrition Programme was set up in 1973 for advising the government on all matters relating to Special Nutrition Programme and for reviewing the implementation of the programmes in the tribal areas and urban slums. The Joint Secretary in the Department of Social Welfare was the Chairman of the Committee which comprised 22 members, including representatives from voluntary agencies. The tenure of the committee was extended year after year.

The Fifth Five-Year Plan laid stress on the evaluation of all major nutrition programmes. It envisaged evaluation to be entrusted to a group consisting of representatives of

the departments implementing the programmes, the National Institute of Nutrition, and other experts on nutrition and social sciences. Since none of the committees is in a position to exercise an overall authority for achieving effective functional integration cutting across different departments and different levels, a Central Co-ordination Committee, under the auspices of the Planning Commission, was suggested in the Fifth Five-Year Plan. The function of this committee was overall co-ordination, evaluation, and monitoring of nutrition programmes. Initially, the member of the Planning Commission in charge of social welfare was the Chairman of the committee with the Secretaries of Health; Food, Social Welfare, Community Development, Education, and Finance as members. However, the Cabinet Secretariat decided later that the responsibility for co-ordination of nutrition programmes would rest with the Social Welfare Department. Accordingly, the Central Co-ordination Committee was reconstituted with the Secretary, Social Welfare Department as the Chairman. The Central Co-ordination Committee on Nutrition Programme was reconstituted on 20th January 1979, The committee comprises the Secretary, Department of Social Welfare (Chairman): Additional Secretary (In charge of Nutrition), Deparment of Family Welfare: Joint Secretary (dealing with foreign food assistance) Department of Economic Affairs: Joint Secretary (dealing with food processing), Department of Food: Joint Secretary, (dealing with Applied Nutrition Programme), Department of Rural Development: Executive Director, Food and Nutrition Board, Department of Food; Joint Secretary (dealing with school feeding programme), Department of Education; Adviser, (dealing with Nutrition) Planning Commission; Adviser (Nntrition) Directorate of Health Services; Financial Adviser, Department of Social Welfare: Director, National Institute of Nutrition, Hyderabad, Chairman Social Welfare Board, New Delhi (Members)

The Committee continued to have the usual wide function which include : To

i) ensure adequate overall co-ordination among the concerned ministries; departments at the Centre, and between Centre and the State Units:

ii) ensure systematic communication and consulation among the various agencies involved in the National nutrution programe :

iii) set up adequate montoring and evaluation machinery at the Centre and State levels and watch the progress of various programmes to ensure a harmonised and meainingful integration of nutrition with other programmes of health and family planning, and environmental sanitation :

iv) keep a watch over the progress of expenditure and provide pooling of financial resources for nutrition at the Centre/State levels for co-ordinated implementation of the nutrition programme :

v) ensure utilisaton of the assistance from international and bilateral agencies for nutrition programme ;

vi) review periodicolly the progress of research schemes on nutrition :

vii) resolve problems pertaining to training and education and any other matter connected with nutrition

viii) consider such other matters as may be necessary, incidental or conducive to the attainment of adequate nutrition level to the nation's population.

The above functions of the Central Coordination Committee do not ensure the required control over nutrition programmes uudertaken by the different departments in the various regions of the country. Especially; the monitoring and evaluation functions are not sufficiently strong to make any

effective co-ordination. This is mainly because the staffing patterns of personnel in implementating item (iii) of the above functions is relatively weak. There are at least two steps needed to meet the situation at an early stage: (1) setting up of a Directorate of Monitoring and Evaluation under the Social Welfare/Food Departments for constant feedback on the efficacy and progress of the programmes, and (2) formulation of the necessary procedures and performance evaluation with necessary frequency for processing informstion. Closer rapport with the State level machinery for mointoring and evaluation has to be established for the governments taking effective steps in this direction. If necessary, the Union Government may also provide financial assistance to the States for strengthening their monitoring and evalntion units.

Efforts made in the past to integrate all nutrition programmes under a single Department/Ministry of the Union Government met with resistance. There are, however, certain advantages in the partial continuance of the present arrangement under which nutrition development is the responsibility of several ministries. As an example, for effective implementation of mid-day meal programme in schools, the involvement of the Department of Education is necessary. For certain nutrition programmes which consist of health care component, the involvement of the Health Department is imperative. Thus, a reasonable degree of decentralisation across departments in implementing nutrition problems is both feasible and necessary. The disadvantages of the much diversification/decentralisation are unco-ordinated approoches entailing excessive costs for achieving the desired targets and denial to eligible vulnerable groups the benefits accruable from limited budgeted resources.

It is most desirable that monitoring and evalution activities are centralised under the Department (either Social Welfare Departmetn/Food Department or Planning Department) for ensuring proper implementation and realisation

of objectives in the context of multi-department involvement. In this case, it is essential that the planning function is centrolised so that common policy objectives and guidelines are evolved for all the implementing departments/agencies. The most important factor that emerges from a proper co-ordination is the periodical surveillance over poverty and the quantitative assessment of the type and degree of malnourishment/poverty*. This is particularly important since the poverty line concept in India is based on the volume of nutrition intake.

Co-ordination is not simply a matter of some performance by a committee that is represented by a number of departments. More important than the composition of the co-ordination committee are the working arrangements; their number and frequency of meetings; the nature and number of issues dealt with, degree of participation (number of members that participate in meetings, etc.); the promptness and efficacy of implementation of decisions and access to new information (including monitoring and evaluation reports). It has, however, to be noted that various inter-departmenttal/institutional communications (in the form of GOs. DO letters and circulars) are only partial substitutes for any reduction in transactions in co-ordination committee meetings. But they cannot be adequate substitutes for periodic co-ordination meetings and effective implementation of their collective decisions.

Co-ordination at the State Level : Tamil Nadu

An examination of the co-ordination activities at the State levei is useful as all the schemes (State/Central/Voluntary) are implemented through State agencies. We will examine the working of two important committees. State

*A good beginning is the notable exercise done in Punjab State by its Planning Commission.

level Standing Committee on Nutrition, and the Co-ordination Committee for the ICDS.

The First Meeting of the State Level Standing Committee (consisting of all the Secretaries of State Departments dealing with nutrition programmes) on Nutrition for Tamil Nadu was held on 16th April 1977. The issue of entrusting the implementation of nutrition programmes to a single agency was considered in 1974 : and it was decided that the status quo-ante should be maintained as the approach in each nutrition scheme is different and most of them are experiments. It was decided that the question of integration of schemes should be considered when, "large resources" become available. The Chairman of the Standing Committee (second Secretary to the Government of Tamil Nadu) asked the Social Welfare Department at the First meeting to examine the issues of (1) unified control of nutrition projects, except mid-day meal programmes at various levels and (2) uniform pattern of administration of these programmes. However, it appears that it could not be achieved so far.

It was proposed at the first meeting of the Standing Committes to hold meeting every six months. The chronology of events relating to this committes speaks for itself.

1. Formation of the Committee in August 1976

2. First Meeting of the Committee in April 1977 (when it was decided to hold the meeting once in every six months)

3. Proposel to convene the second meeting in December 1977

4. Second meeting actually held in January 1978

5. Abolition of the Standing Committee in May 1978 consequention constituting Children's Board November 1977.

The State Level Co-ordination Committee for Integrated Child Development Services (ICDS) Programme. sponsored by the Union Government was constituted in July 1976. Its first meeting was held in July 1977. The second meeting was held in January 1978. The Chairman—Minister for Social welfare—observed that the Committee being an important body should meet once in three months and help in the effective implementation of the programmes. The third meeting, scheduled for November 1978 was held only in December 1978. The fourth meeting proposed to be held in Ndvember 1979 was postponed indefinitely. It did not meet till May 1981.

Some of the officials feel that meetings are a waste of of time, particularly when they are scheduled and postponed. The entire preparatory work is of no avvil. Though some senior officials feel that time is wasted in too may meetings, clearly this state of affairs does not make for efficient co-ordination. The futility of some of the meetings is often due to incomplete, inaccurate information base for discussion in addition to possible ill-motivation on the part of some of the functionaries.

However, recently the Government of Tamil Nadu constituted a High Level Co-ordination Committee, headed by the State Chief Secretaty, and the Committee includes Second Secretary to Government (as Vice-Chairman), Secretaries of the Departments dealing with Social Welfare, Rural Development, Health and Family Welfare, and the Project Coordinator of the World Bank Nutrition Project. A few permanent special invitees are also included. It is stipulated that the Committee will meet once in three months. The main objective of the Committee is to "co-ordinate the regular flow of informction, exchange of views, etc, among the "im palementing agencies". The Committee is in the process of streamlining the information flow process and it is hoped

that soon the tasks will be accomplished, and a set of indicators for monitoring and evaluation are drawn up. These should be closely related to individual programme features; some of the suggestions given in the latter sections of this report may be relevant in this context.

Child Nutrition Programme at Different Levels

Since child nutrition is the most important component of the nutrition sector, it is appropriate to review and analyse, especially the recommendations of the different committees set up by the Union Government for evolving guidelines. In the following paragraphs, the organisational aspects and functions envisaged for the different co-ordination bodies and the reports of the committees are briefly reviewed to provide a historical perspective on the organisational featurers for co-ordination/implementation.

The Committee for the Preparation of a Programme for Children (1968) set up by the Govenment of India, made the following recommendations :

A comprehensive national policy and programme for child welfare, covering a wide range of services, could be successfully formulated implementd only if a unified view is taken of the child welfare, and priorities are clearly laid down, and the progress periodically assessed. In the absence of an intergrated view and proper arrangements for co-ordination, the tendency for working in set grooves and individual programmes being deemed as ends in themselves is likely to develop.

A high-level National Committee on Child Welfare should be constituted under the Chairmanship of the Prime Minister and should include the representatives of the concerned Ministrees, the Planning Commission, State Governmenh, and voluntary organisations. The functions of the Committee should, inter alia, be to :

(i) take a unified view of the needs of children.

(ii) in the perspective of economic and social development at home and abroad and to review periodically the progress of programmes for meeting these needs.

(iii) consider the various aspects of national policy for child welfare, including the objective and priorities.

(iv) promote co-ordinated and cooperative efforts among the various governmental and private agencies engaged in implementing child welfare programmes.

(v) formulate the criteria for securing reasonable allocations in the national plan for child welfare programmes.

3. Committees with similar functions should be set up in the States under the Chairmanship of the respective Chief Ministers and should include representatives of the State Departments concerned and State-level voluntary organisations.

With the setting up of the National Children's Board under the Chairmanship of the Prime Minister in 1974 and formation of similar boards in some of the States, it is evident that the main recommendation of this committea has been given effect to.

The Report of the Study Group on the Development of the Pre-School Child (1972) (Ministry of Education and Social Welfare, Government of India), after outlining the broad objectives of pre-school child development through the delivery of health, nutrition and educational services, made a strong case for inter-departmental co-ordination and integrative approach for administration of these services.

The Study Group argued : "It is obviously not possible for any single agency to accept responsibility for this programme as a whole. Our objective, therefore, should be to bring together the different agencies concerned to coordinate their efforts so that a programme of integrated services is provided for the total development of the pre-school child without any duplication, with maximum efficiency and at minimum costs".

On administration it recommended : "Implementation of a comprehensive programme of the kind detailed in this report requires a strong administrative machinery at all levels National, State, district, and local (rural and urban)":

i) National level : In order to ensure an effective central machinery for the co-ordination of the programme at national level, a national committee for the pre-school child should be set up under the chairmanship of the Union Minister for Education and Social Welfare. A Directorate for Pre-school programmes will look after the effective implementation of the decision of the Committee.

ii) State level : The department responsible for the administration of this scheme at the State level will differ from State to State. Where more than one department is involved, a co-ordinating machinery must be created. A full-time officer of appropriate status will have to be made responsible for the programme.

iii) District level : The district being the appropriate administrative unit for effective co-ordination in the field, a suitable committee should be set up with representatives from the various agencies engaged in schemes of child welfare. A full-time officer of the status of a district officer and working directly under the collector should look after the implementation of the programme.

iv) Local Bodies - Rural : Supervisors placed under the control of Zilla Parishad or Panchayat samithi should be provided with transport facilities to enable them to function effectively.

v) Local Bodies - Urban : A standing committee of the Municipal authority concerned should supervise the programme in urban areas. A special officer should be entrucsted with the execution of the programme.

The proposed national committee need not be confined to cover only pre-school child nutrition programmes despite this fact that the pre-school child age group (0-8 years) is the most vulnerable. Within the category of children, this group should be accorded priority. It is also dobtful if the Union Minister for Education and Social Welfare in his/her capacity as the Chairman of the Committee could muster necessary co-ordination from other Ministries/Departments.

The Committee on Pre-School Children Feeding Programme (1972), set up by the Planning Commision, reviewed and analysed the existing feeding programmes, and made a strong plea for evolving new patterns of departmental relationships. On co-ordination and evalution the committee recommended : "The success of the programmes of supplemental feeding will be dependent on the effectiveness of the machinery in States, not only for implementation of individuals programmes but for their integration and co-ordination. For this purpose, the Planning Commission has recommended constitution of a Co-ordination Committee in each State. We suggest that the States which have not set up Co-ordination Committees should constitute such Committees early. It will be necessary for these Committees to meet at least once a quarter. Similar Committees may be set up at district Level.

The functions envisaged for the State-level Coordination Committees for Nutrition are to :

(i) work out, as far as possible, uniform pattern of procurement, storage, and distribution of foodstuff.

(ii) avoid overlapping in setting up feeding centres and in coverage of beneficiaries.

(iii) lay down guidelines for effective supervision and implementation of feeding programme by co-ordinating the functions and responsibilities of field staff presently appointed under different agncies.

(iv) work out in-service training programme from time to time for field staff as well as for voluntary organisations involved in implementation of feeding programmes.

(v) organise conference and seminars from time to time on pre-school children feeding programmes.

(vi) prescribe performance standard and obtain quarterly reports regarding progress and to evaluate them from time to time.

(vii) examine evaluation reports on feeding programmes and track quick decisions on them.

It may be observed that although the State-level Coordination Committees are generally constituted, the meetings are not held every quarter as suggested in the report cited above. Also, the feedback information system (expected via monitoring and evaluation activities) is very weak, thus rendering some of the tasks of the Committee impossible to fulfil.

The National Children's Board was constituted in December 1974 with the Prime Minister as its President. The functions of the Board include planning, supervision, co-ordination, and review of various programmes for the welfare of children. Although this is an apex body and has nutrition programmes among various other programmes, the frequency of its meetings (which is once a year — its Standing Committee, however, meets twice a year) is such that it can only overview and give broad policy directions; the information-base for decision-making at this level is also meagre since the Board itself does not have sufficient staff for collecting and analysing detailed information.

Scope for Improved Co-ordination

There is need for improved co-ordination between departments, and agencies, both at the Central and State levels. The conventional approach categorises most nutrition programmes as independent set of activities, often in the form of distribution of food-stuffs to appease a few groups of vulnerable population. The costs of these programmes are considered and benefits are either assumed to accrue automatically or not properly monitored. A desirable and important departure in the approach towards these programmes, especially at the planning stage, is the integration of these important inputs strongly linked to other parameters of socio-economic development, especially the potential to raise the human capital leading to higher levels of labour productivity. The economic benefits due to improved nutrition status discussed in the Main Report (Demand for Nutrients) emphasise the need for this approach.

From the view point of operational development, a quantitative assessment of poverty reduction over time in different areas would be a very useful exercise. This can be carried out only after assessing the socio-economic conditions with special reference to into in takes of nutrients. The co-ordinated effort in this direction is very relevant. For this purpose, a high-power National Committee on Nutrition is required with the Prime Minister as Chairman and Secretaries of all economic Ministries/Departments and those dealing with different nutrition programmes as members for ensuring effective co-ordination. Alternatively, the National Children's Board (formed in 1974) can take more effective steps in co-ordinating programmes relating to children which form the main thrust of activities. This would require strengthening the Board with skilled manpower and organising relevant system of data-base to enable effective decision-making. Constitution of a sub-Committee which can serve as a Standing Committee of this National Committee would be useful, so that it can meet at preferable frequencies. The recently formed inter-ministerial co-ordina-

tion committee under the Chairmanship of M S Swaminathan can possibly serve this purpose, if this could continue as a permanent institutional arrangement. Similariy, at the State level, the Standing Committee on nutrition with the Chief Minister as the Chairman, and Secretaries of concerned Departments as members should be constituted to ensure better co-ordination, with the stipulation that it should meet at least once in a quarter.

The functions of the above co-ordination committees should include co-ordination, both in planning and implementation. With financial resources made available by the Planning Commission/Finance and Planning Departments, the committees should be able to ascertain optimal utilisation of organisational, administrative, technical, and other material inputs under different programmes and continuously update information through monitoring and concurrent evaluation. Such a resource mobilisation would enable to overcome the possible bottlenecks in implementation, with corrective steps devised in operational planning of activities and periodical appraisal of results. Accountability will be greater in this approach than in the present arrangements of co-ordination. Invariably nutrition and social sciences experts should be closely associated, specially with the planning monitoring and evaluation exercises—both at the Central and State levels.

Co-ordination efforts will be effective only when necessary technical/expert support for proper analysis of alternative policy approaches and instruments in relation to its impact on food and nutrition objectives is constantly available. In this context, the recommendations of the Multi-disciplinary Research Committee constituted by the Department of Food for the setting up of Food and Nutrition Policy Research Centre merit favourable consideration. This Centre should also provide technical support to monitoring and evaluation endeavours in different ministries.

One line of departure from the suggestions contained in various study reports reviewed in the previous section may be

warranted. It is the recognition that various seemingly non-nutrition programmes like provision of protected water supply drainage facilities, expansion of schemes of preventive medicine, improved medical facilities, etc, have as much as bearing on nutrition status as some of the nutrition feeding programmes. Conventionally, nutrition programmes are taken to include only the feeding programmes for whichever target population they might be decided upon. The above recognition would imply that with various co-ordination committees whether at national State or project level, the concerned ministries dealing with the programmes/projects which have significant bearing on nutrition status should be involved. Thus, a number of ministries/departments like panchayat raj, rural development, health, etc. (depending upon the inclusion of different functions under different ministries/developments) should be represented on the co-ordination committees. It is essential that necessary information based mainly on surveys, monitoring, and evaluation activities regarding different schemes in operation is made available to the co-ordination committee to make its functioning effective and a co-ordinated effort made to maximise nutrition benefits for a given package of resources alloted to various departments/ministries.

An important and useful aspect of co-ordination at the sub-State levels (like at the block district/project/specific areas) is the desirability of combining training programmes for the middle and junior level functionaries with the co-ordination meetings.

The important pre-requisites for effective co-ordination may be summed up as under :

1. The political will and administrative commitment to achieve improved results—results not in terms of expenditure statistics or resource allocation indicators, but based on factual information relating to type and magnitude of nutrition beenfits (whether based on clinical, anthropometric or other mea-

sures of improved nutrition status—or as the next approximation, to improved intake of nutrients by target groups;

2. Appropriate composition of the co-ordination committee representing various departments/agencies involved in policy formulation and implementation of schemes which have direct and indirect bearing on nutrition status of the target groups; this would also include the proper selection of the Chairman of the committee, mainly based on his status in government so that he can effectively control various activities and give directives to various departments and other agencies:

3. Information-base for decision-making is an important consideration for an effective co-ordination; availability of dependable and timely data through various surveys, monitoring, and evaluation activities on time: this includes evolving feedback information systems for proper planning and implementation, and timely action for corrective measures;

4. The frequency of meeting should be need-based, that is, the meetings should be held depending up on the type and intensity of different activities and intensity of different activities and seasonality. Quarterly meeting is a must for co-ordination to be effective.

3

Monitoring and Evaluation

For evolving effective methods of monitoring and evaluation of nutrition programmes, it is essential to precisely clarify the short-term and long-term objectives of the programmes. Closely linked with this aspect is an assessment of the criteria for identification of geographic regions and sections of population being covered under nutrition programmes of different types, either directly or indirectly, that is, through applied nutrition programmes or through other nutrition intervention strategies, including improvement of environment via protected water supply schemes and sanitation. The criteria could be besed on the (i) physiological, and/or (ii) socio-economic parameters, or (iii) administrative and political choice. The last consideration is applicable to higher level of decision-making in terms of choosing the geographic regions for the operation of one or more of nutrition programmes and also possibly to set certain guidelines for possitie choice of criteria under (i) and / or (ii), However, even after the guidelines are available, exercise of certain judgment is inevitable in operationalising the criteria, either using physiological specifications or by meticulous observance of socio-economic characteristids while selecting various groups of beneficiaries under different nutrition programmes.

The incidence of any nutrition programme can be judged with reference to the objective criteria of performance in respect of which it can be measured. To make the incidence measurable mainly by physiological development of the target group of the population like children, pregnant women, etc,

it is essential to schedule the oporations involving the input-output activities, (inputs being the different nutrition programmes, their content and the extensity. and the output being the specified measurable criteria of performance). This calls for proper choice of the periods over which the output is observed and the input is improved. Unless the criticality of the quantity and time variation of inputs as well as the time duration of outputs is recognised, it is difficult to assess the incidence of nutrition programmes. One hardly comes across any detailed investigation which recognises these features and throws light on the incidence of nutrition programmes, isolating it from other parametars of the socio-eoonomic system. Only when monitored to ascertain the adherence of thes criteria while selecting the beneficiaries, the effectiveness of the same can be known insofar as the distribution of nutrition inputs is concerned. In the absence of well-defined, criteria for the assessment of the impact of nutrition inputs, tne nature and magnitude of effects of nutrition programmes remain ambiguous. Thus, the evaluation of nutrition programmes in the absence of precise criteria may continue to be the weakest aspect of a nutrition project and, thus, the programme stands to be a major failure unless short term and long-term measures either by concurrent evaluation or by elaborate monitoring of the impact of nutrition inputs is worked out.

The approach in selecting the beneficiaries for the various nutrition programmes in Tamil Nadu was, by and large, based upon the socio-economic considerations and not on physiological/clinical conditions. However, for the purpose of the World Bank support to the Nutrition Project specific clinical criteria are evolved. From the welfare poinr of view and from the fact that there exists high correlation between these parameters and nutrition deficiencies. there are a few objections to choosing the beneficiaries based on socio-economic considerations.The problem, however, is that since the entire-eligible population in the State or a given region (based on socio-economic criteria) are generally not benefited by the programmes (due to limited budget availability) it is desirable

that supplemental criteria based on physiological parameters are used to reduce the size of the eligible set of beneficiaries so that they may be given better doses of nutrition.

Identification of Risk-prone Infants

The following criteria were identified by the Central Nutrition Bureau of the Directorate of Public Health and Preventive Medicine, Government of Tamil Nadu. These criteria were evolved recently for identifying the target-group of children for different nutrition development programmes for the World Bank Nutrition Project :

1. One parent only
2. Working mother
3. Non-pregnant meternal weight below 38 kgs
4. Chronic diseases of parents
5. Quick spacing
6. Higher birth order
7. History of death of siblings
8. Breast-feeding NIL or insignificant
9. Twins and multiples
10. Birth injuries
11. Birth defects
12. Low birth weight single-tons
13. Failure to gain weight in three successive months
14. Weight less in two successive months
15. Second degree of malnutrition and underweights
16. Illness, such as age, repeated diarrhoea, whooping cough and eruptive fevers
17. Malnourished siblings
18. Features of detrimental environment, social, physical and biological

The criteria developed by the same source for the identification of the target-group of pregnant and lactating women considered nutritionally at risk are as follows :

1. Weight 38 kgs or less at the time of confirmation of pregnancy or weighs 41 kg. or less at the 28th week of pregnancy
2. Severely anaemic (less than 70% on the tallquist scale)
3. Height is less than 145 cm.
4. Has a child who weighed less than 2.4 kg. at a previous delivery
5. Has high blood pressure (130/90 or above)
6. Is a Primipere of below 18 or above 30 years of age
7. Has a history of abortion or slill birth during the previous pregnancy
8. Has lost her child within one month after the previous delivery
9. Is carrying her (fourth) or later child
10. Has a history of bleeding during pregnancy
11. Has jaundice during pregnancy or is a known case of T.B., heart disease or diseases.
12. Is possibly carrying twins.

The above criteria are now being adopted in implementing the schemes under the nutrition project supported by the World Bank.

Basically monitoring activities should focus attention on

(i) selection of eligible beneficiaries-adherence to specified criteria.

ii) coverage of schemes in specified areas and target groups.

iii) administrative, technical and other resource availability for implentation of programmes

iv) progress of implemention according to time schedules

The evaluation activities should analyse (i) the conformity of the scheme to the objectives the operationalisation of higger level objective to lower level obiectives- identification of discrepancies, if any, (ii) assessment of programme benefite/results in terems of these objectives (iii) identification of respective contributions of different inputs ard factros which effect the success of the programmes, and (iv) suggestions for formulationg and implementing future programmes.

A Review of Nutrition Programmes in Tamil Nadu :

The above discussion is fairly general and is ueeful to confine some attention to the on–going nutrition programmes in Tamil Nadu. The analysis below is based on secondary sources of information, various documents gathered from the State departments and other organisatians. A number of nutrition programmes have been in opearation under different Department in Tamil Nadu, for varying time-pariods (depending mainly on the date of commencemeni). Table gives details of different programmes, implementing Departments type and number of beneficiaries, number of feeding days in a year, feeding centres and the food items supplied under theee programmes. Potential (not necessarily effective) contribution in terms of increased intake nutrients (calories and proteins) under different programmes per beneficiary per day of participation in the feeding programme is givin in Table 2. Although quantitative assessment of additional intake of nutrients due to these programmes by the eligible beneficiares is difficult to assess, a number of studies revealed that the implementation of these programmes is beset with lacunaa. Some of these are specified in the subsequent paragraphs.

It may be useful to examine the process of selection of eligible beneficiaries at first. A circular from the Directorate of Social Welfare issued in December 1979 refers to an office order of November 1975 which states : "It has been brought to the notice that the beneficiaries for special nutrition programme feeding are selected at random inspite of specific

TABLE 1 : Nature of Feeding Programmes in Tamil Nadu

(1976 - 77)

Programme title	Sponsoring Agency	No. of feeding days in a year	No. of feeding centres	Type of beneficiaries	No. of beneficiaries	Food items supplied
1. Mother & child welfare programme — Balwadis	Department of Social Welfare, Govt. of Tamil Nadu	300	1604	Pre-school children, pregnant & lactaj-ing mothers	1,10,000	Bulgar wheat/ balahar & salad oil
2. Special nutrition	-do-	300	640	Children (0-6 yrs) P/L mothers	1,36,000	Balahar & salad oil
3. Modified nutrition programme	-do-	300	77	-do-	1,40,000	Balahar
4. integrated child development services	-do-	300	300	Pre-school children, P/L mothers	28,000	Balahar & salad
5. Kuzh ntnigal kappagams (Post ANP area)	Department of rural Development, Govt. of Tamil Nadu	300	1 000	-do-	1,00,000	-do-

6.	Applied nutrition programme (ANP area)	-do-	300	398	-do-	30,000	Balahar/salad oil, vegetables and egg.
7.	Maternity & child Health feeding programme	Department of Public Health Govt. of Tamil Nadu	300	3052	-do-	1,30,000	-do-
8.	Industrial mutrition gramme	Department of Labour, Govt. of Tamil Nadu	300	62	Pre-school children P/L mothers	30,000	Bulgar wheat/ balahar & salad oil
9.	Midday meal scheme	Department of School Education, Govt. of Tamil Nadu	200	32,000	School children	11,61,978	Bulgar wheat/ balahar, par-boiled rice, vegetable & oil
10.	Corporation school meals programme	Corporation of Madras	200	350	-do-	50	C.S M. Bulgar wheat, rice, salad oil, vegetable & skimmed milk powder

Source : S Rajagopalan (1980) : Nutrition Programmes in Tamil Nadu - an Overview. TNNP, Madrass.

TABLE 2 : Nutritional Contribution of Feeding Programmes in Tamil Nadu

Programme title	Quantity of food supplied				Nutritive value of the food supplied		Nutrients/Ben/day		Cost/Ben Day
	Food grain (M.T.)	Salad oil (M.T)	S.MP* (M.T)	Egg (M.T)	Calories (in '000) k.cal	Protein (in '000) gr.	Calo-ries k.cal	Pro-tein (g.)	Rs. Ps.
1. Mother & child welfare programme - Balwadies	2110	190		—	9306000	506400	282	15	0.31
2. Special nutrition programme	2610	230	—	—	11466000	626400	281	15	0.30
3. Modified nutrition programme	5110	—	—	—	18386000	1226400	438	29	0.36
4. Integrated child development service	805	60	—	—	3438000	193200	397	22	0.46
5. Kuzhantaigal kappagam (Post ANP area)	1915	169	—	—	8415000	459600	280	15	0.28
6. Kuzhantaigal kappagam (ANP area)	575	61	—	83	2672590	149040	296	17	0.52

7.	Maternity & child health feeding	2490	220	—	—	10944000	597600	280	15	0.26
8.	Industrial nutrition programme	575	50	—	—	2520000	138000	280	15	0.24
9.	Midday meal scheme	13998**	1482	—	—	97200000	5590800	418	24	0.43
10.	Corporation school meals programme	9297@ 363** 280	118	227	—	4187290	23370	418	23	0.85
		40128	2570	227	83					

*Skim milk powder **Quantity of foodgrain gifted by CARE @ Quantity of foodgrains acquired by the sponsoring department

Source : S Rajagopalan (1980) : Nutrition Programmes in Tamil Nadu - An Overview, TNNP, Madras,

instructions issued in this office proceedings." The fact that the beneficiaries were selected without using the criteria was realised only after four years of the issue of guidelines brings out the need for strict and constant monitoring and concurrent evaluation. Obviously resources were being misutilised on a large-scale in the absence of proper monitoring.

A review of some of the nutrition programmes being implemented under different programmes in Tamil Nadu revealad the following features :

a) Mother and child welfare programme Balwadis:

The Department of SocialWelfare is operating balwadis mainly for the pre-school children. Age and socio-economic background are the main crlteria for selecting the child for this programme. But physiological considerations are waived for entry eligibility and also for exit from the programme. Also, it is not always ensured with the same set of eligible children always to take advantage of the programme. Only after allowing the food to be taken home, there was reportedly greater participation of children. This obviously shows that when quantities are moved out of the distribution centre, they could be used for a number of puiposes (including, of course, feeding of other members of family). The number ot children involved is fixed and limited to 40 per balwadi centre, regardless of the village population. It is desirable that the policy is made more flexible and the size of the eligible children population should be assessed for the purpose of organising the feeding of the children and not necessarily limited to the fixed number 40. Also, in some villages the number may be fixed at less than 40, where the need is less. Thus, a need-based aporoach rather than ad-hoc administrative approach, would be effective in this programme. Strict monitoring and evaluation is a must to test the efficacy of the same. The feeding of the eligible children participating in this programme is more important than statistics of the

total number of children fed at different periods with no specifications whether the set of children remain fixed or randomly varied. Although attendance registers are maintained in each centre, no statistics in respect of the continuance of any fixed set of eliaible children are available.

Special Nutrition Programme :

This programme was launched in 1971 is Tamil Nadu to provide supplementary food for children in the age group of 0-6 years in tribal areas and in city slums. The Directorate of Social Welfare is primarly responsible for these activities. In 38 municipalities, the programme is locally supervised by the municipal officers. The organisers and the helpers in the local feeding centres receive an honorarium of 10 paise and 5 paise, respectively, per beneficiary, and a cook gets a total remuneration of Rs. 30 to 50 per month. It is very doubtful, if the staff were available only for this very meagre remuneration, unless there were other types of remunarafion involved. In the feeding centres, there are only one or two voluntary workers to distribute the food and supervise the feeding indipendent of the number of beneficiaries. Because of employing limited staff apparaently led to considerable handicaps in the efficient management of the programme.

Modified Special Nutrition Programme

To link up health and family planning with special nutrition programmes, this new scheme was launched in 77 centres spread over the cities of Madras, Madurai, Coimbatore, and Pudukottai. The programme is implemented through corporations/municipalities and maternity centres. There are no specific norms of listing the eligible beneficiaries.

Kuzhanthaigal Kappgams under Directorate of Rural Development

The norms for the selection of the eligible beneficiaries in this scheme also lack clarity. It is only mere replication of

other schemes like balwadis but managed by different departments. At the block level, the BDO is responsible for the implementation of the programme. This District Women Welfare Officer is incharge of the Programme at the district level. There is a joint Director and a Project Nutrition Officer responsible for the implementation of the programme at the State level. The Balwadis working in the centres receive a remuneration of Rs. 75, of which Rs. 55 are borne by the Department of Social Welfare, and the remaining by the Department of Rural Development. The Ayas working in this are paid Rs. 30, of which Rs. 20 are contributed by the Department of Social Welfare, and the remaining Rs. 10 by the Department of Rural Development. This scheme is one of the most inter-linked with little accountability on the part of five departments involved in the implementation with no effective control, monitoring and evalution.

Applied Nutrition Programme (ANP) under Directorate of Rural Development

This is one of the older schemes initiated in 1962-63 aiming at self-help by the community to eradicate malnutrition. Studies show that this programme did not make any signficiant impact. An all-India study of ANPs* came to the following conclusions which are generally applicable to Tamil Nadu also :

i) The selection of villages was generally influenced by the level of socio- economic development attained by the villages rather than by the potential for development or the necessity for ANP (not all ANP schemes were taken up simultaneously in the selected villages). Often, it took two to three years before all ANP schemes meant for the selected villages could be started.

---

*Desai G.M., B.R. Gaikwad : *Applied Nutrition Programmes- An Evaluotion Study. IIM, Ahmedabod. 1971.*

(ii) Various schemes under ANP were not introduced in the selected villages in a co-ordinated manner-there was common desire to spread the programme in as many villages as possible. These haphazard steps led to the implementation of various ANP schemes as ends in themselves, instead of being components of a co-ordinated programme. the coordination committees for ANP have not been constituted everywhere, and where they were constituted they met infreqently.

(iii) Community garden scheme failed to increase the supply of vegetables and fruits and to provide a part of the supply for the feeding scheme as voluntary labour force was not forthcoming.

iv) The production schemes, such as community garden, poultry, and pisciculture entrusted to panchayats and voluntary organisations have also failed in enlarging the supply of vegetables, eggs, and fish on economic lines. They could not generate a steady supply of food for the feeding scheme. The most important factor for this failure is the lack of commitment on the part of the panchayats and voluntary organisations to provide active day-to-day management. Panchayati raj institutions as they are operating are primarily political institutions and not agencies for implementing community- based production schemes. Consequently, their objectives are very different from the objectives of production schemes. For the same reason, they do not have capabilities to provide sound management for such schemes.

It is useful to highlight some of the findings of an evaluation study carried on by ANP, Special Nutrition programme, Corn-Soy-Milk and Balahar feeding programme in Tamil

Nadu. A summary of the findings of the study conducted by the Evaluation and Applied Research Desartment, Government of Tamil Nadu, is given below:

The objectives of the above supplementary feedings programmes were to : (a) identify those areas and sections of the popuiation of the pre-school children and pregnant and nursing mothers among whom malnutrition is most widespread (b) bridge the gap in the calorie intake of these sections nf the population by providing one supplementarp mval every day for 300 days a year; provide minimum health care and immunisation to the selected beneficiaries.

The findings of the study are :

(i) Feeding is not confined to the stipulated target group. About 15 per cent of the present beneficiaries could have been replaced by more deserving persons. The method of selecting beneficiaries is quite arbitratory. This made the of excution of programme indifferent. The nutritional status of the beneficiary is not taken as a criterion in the selection process. There is wide sharing of food, and no effective participation of the identified group in the programme. The actual turn out is only 93 per cent of the total strength. The participation of mothers is particularly poor. Two-thirds of the beneficiaries took home the food and shared with more than one member in their household.

(ii) Regularity in feeding is disturbed by inadequate and untimely supplies of fuel materials. Regular, timely and sufficient supply of food material is essential if the scheme were to achieve the proposed benefits.

There is insufficient space available for storing, cooking, and eating. No care is taken to check the progress of the beneficiaries Consequently, the programme cannot be properly evaluated. The medical officers should be asked to check the beneficiaries regularly. About 74.6 per cent of the parents reported that they we rot aware of any improvement in their children. About 9.7 per cent reported improvement in their children's health, and 15.7 per cent denied improvement.

The following steps have to be taken in designing and implementing the nutrition programmes :

(a) Feeding should be regular and confined to the target group

(b) The identified group should wholly consume the food (sharing should be avoided)

(o) Continuity of feeding at least for a critical minimum period for each beneficiary should be assured

(d) Preparation of food should be hygenic and nutrition conserving

(e) There should be periodical health checks and progress watching by qualified medical officers

As regards other nutrition programmes too, a number of lacune can be observed in their implementation. However, some of the bottlenecks are beyond the control of the implementing agency. For example, in the case of the Integrated Child Development Services (ICDS), according to the Evaluation Study (1977) of the Planning Commission, New Delhi, the immunisation programme and health check-up are not properly executed; "In no block health centres were found to give satisfactory performance. Laok of sufficient staff or lack of appropriate supply of medicines are the common problems everywhere".

It is apt to note the following observations from the Report of the Task Force (Sixth Plan) Nutrition Policy, Planning and Implementation :

(a) "Considerable substitution of food has taken place in the feeding programmes in Tamil Nadu. The programme efficiency has been judged generally by the effectiveness of the delivery system in planning and obtaining the qualities of foods received by the feeding schemes. The administration was concerned much more with the "accountability," of the food distributed rather than estimating the actual cosumption by the targetter beneficiaries. Data for determining the total effects of intake was virtually absent."

(b) So long as the success of plan implementation is judged mainly by how quickly financial allotments are exhausted and not how efficiently, quickly, and economically, real benefits are built up laterally as well as vertically through careful husbanding concerted management and improved maintenance through feats of cooperation between the gavernment machinery and community participation programme will be condemned, as in the past, to precisious tokenism and conspicuous internal charity, leaving little residual benefit".

It is clear from the above review that there is an urgent need for, and considerable scope to, improving the efficacy of different nutrition programmes in Tamil Nadu without drastic alteration of the existing organisational network. Specific measures for improved co-ordination, monitoring, and evaluation, in addition to some operational norms outlined earlier are likely to positively affect considerably the nutrient intake by the target groups.

In the next section, it is proposed to deal with some important characteristics of the monitoring and evaluation activities, besides reviewing the functions and the role of the National Nutrition Monitoring Bureau.

Scope for Improved Monitoring and Evaluation

A world wide survey of nutrition programme conducted by the Harvard Institute of International Development during 1976-77 reveals that out of 140 programmes, only 23 percent reported that nutritional status data are analysed and only 15 per cent had analysed their data on programmes costs. The monitoring and evaluation of nutritional programmes have thus been very much neglected and largely deficient in developing countries. Without sufficient information on the relative efficacy of the different types of nutrition programmes there is no justifiable and clear the basis for investing resources in the future. Projects with clear and specific objectives can be effectively monitored with relatively simple information systems concentrating on key indicators only. "Communication of sensitive information of project management and the responsible agencies can present serious problems in the Asian cultural context". Scepticism, suspicion, distrust on the part of the authorities more often render the monitoring and evaluation system very ineffective.

For monitoring purposes, it is useful to define the project inputs, project effects and project impact. Monitoring would cover gathering of information on project inputs, outputs, effects, impact and also complementary activities that are critical to the attainment of the objectives of the project.

The purpose of evolving "on-going evaluation" (or concurrent evaluation) on a continuing basis is to enable the project management to organise and make the policies, objective, institutional arrangements and resources affecting the project purposive during implementation. The translation of policy objectives into operational objectives at different

level is imperative for proper monitoring and evaluation. Ex-post evaluation is generally carried out after completion of the project to find out the effects and impact so that this information could be useful for future project planning.

An evaluation system, either on-going or ex-post, should consist of : (i) purposes of evaluation; (ii) specific hypotheses to be tested; (iii) key indicators; (iv) survey and sample characteristics; (v) design of questionnaries and organisation of field data gathering; (vi) data tabulation, processing and analysis procedures, and (vii) reporting procedures for evaluation results with a bearing on operational steps involved in making practical changes based on the results.

There are mainly three aspects of monitoring and evaluation :

(i) **Managerial aspects**: Monitoring and evaluation should provide information on implementation in relation to project planning and its objectives; identify the bottlenecks, if any, and also suggest ways in which project management can take remedial actions in time. Experience shows that few managers are committed to monitoring to improve the syetems through fee back information. Also, information generated by the monitoring units is not always of uniform quality and its periodicity is always as per the requirements of project management. Excessive information irrelevant to management needs often dissuades the potential users from making proper use of necessary data. The need for evolving key indicators for project monitoring and according high priority to the timely dissemination of information is obvious. Evaluation which should comprise analysis of the success or failure of cases in respect of different components of the project implementation is necessary to improve the on-going as well as future efforts.

(*ii*) *Technical aspects of monitoring* : Judgment on the composition of key indicators is an important pre-requisite for maintaining resasonable quality of data/information. Elaborate questionnaire often-erode goodwill of the recipient in extendir g cot operation. The choice of appropriate sample size for eliciting information is an important aspect of monitoring. Statistical analysis could be carried out only if the sample design is properly determined. Also, the fact that estimation with relatively smaller sample size would be adequate in a situation in which the target population is either from large or more or less homogenous households should be recognised for sampling purposes. Converting data into information is vital for effective monitoring and evaluation systems. This would warrant identification of requirement of information at different levels for decision making.

(*iii*) *Institutional aspects of Monitoring*: In the long run creation of monitoring and evaluation mechanism within the projects is desirable since this would notonly provide continuous information throughout the life of the project but also make available more direct feed-back to the management at lower costs. Although project managers are not expected to be familiar with the techniques of monitoring and evaluation, the symbiotic relationship between the project management and the monitoring and evaluation unit should be clearly recognised.

The multi-level approach for evaluation, suggested by the Evaluation and Applied Research Directorate of the Tamil Nadu Government,[2] in the context of the World

---

2. Evaluation Destgn - Integrated Nutrition Project. Evaluation and Applied Nutrition Deparrment, Government of Tamil Nadu 1980.

Bank Nutrition Project is useful and should be adopted for all other nutrition programmes in Tamil Nadu. A brief synopsis of the approach for evaluation is given below;

"In the very nature of things, evaluation in respect of this project has to be concurrent, not only in relation to the immediate and intermediate objectives of the project but also impact of the scheme As the project has a hierarchy of objectives, such as, (1) ultimate objective (2) intermediate objective, and (3) immediate objective, it is proposed to adopt both concurrent evaluation and terminal (impact) evaluation".

"Concurrent (on-going) evaluation is an action-oriented analysis of project effects and impacts. Compared to anticipations, it will be carried out during the implementation of the project. It will suggest solutions to problems of project execution, some of which may have been identified as a result of monitoring. A major objective is to make an in-depth assessment before project completion of whether the project target group is getting the benefits of various components as these are implemented. On-going evaluation is also necessary for policy makers to adopt the project to changing objectives and circumstances or to a better perception of the projects' sociological environments. It may result in adjustments in implementation strategies, in resource allocation, in the design of the project or in supporting policies. Thus, in short, on-going evaluation would work towards bringing the project to fully effective operations".

Role of National Nutrition Monitoring Bureau (NNMB)

In the present context, it is useful to examine the existing national organisation for monitoring nutrition in terms of its current operations and possible role. The NNMB located at the NIN, Hyderabad (under the ICMR), was established in

1972 with the objective of continuous monitoring and evaluation of nutrition status in different States. The Bureau has regional units in Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal, and Orissa. The NNMB has devised methods of data collection and processing so as to enable assessment of nutrition status among different socio-economic groups in different areas. Analyses of dietary habits is also part of this data collection process. Clinical, anthropometric and diet surveys constitute a major part of information gathering; set of questionnaires/proformae for data collection have also been evolved by the NNMB for collecting relevant information at block, village, household and individual leavels which comprise the three components of surveys mentioned above. In the case of select districts in various States the information generated by the NNMB includes consumption pattern of different income groups in rural areas.

It is useful to recall the background [3]for the creation and functions of the Bureau:

"During the past few years, a number of nutrition programmes, sponsored both by the State Government as well as the Central Governmeut, have been in operation..... The impact of those programmes on the nutritional status of the community has, however, not been properly evaluated so far. Because of these considerations, it was felt necessary to have a continuous monitoring service to study the nutritional status, dietary habits, food availability and the effect of changing social and environmental factors on the health of the population. The results of such a study carried out on representative segment of the population in various parts of the country would provide information and useful guidelines not only for food policies of the country but also to assess the impact of nutritional programmes currently in progress and for future planning".

3. National Nutrition Monitoring Bureau—Plan of Operation. NIN, Hyderabad, 1975.

Whereas the data gathered by the NNMB leads to reasonable assessment of nutrition status by various methods in specific areas, the approach and the type of information collected does not render itself to the assessment of the impact of various intervention programmes in operation. The results obtained by the NNMB on various parameters can be related to some of the main socio-economic parameters but fall short of isolation of relevant impact of different nutrition programmes sponsored by the Central and State governments. Given the network of the NNMB and expertise. the scope of nutrition information collection and data processing can be widened so that the results become more useful from the policy point of view to ascertarn the relative efficacies of different nutrition programmes. In other words the concurrent evaluation should be integrally combined with monitoring function of the Bureau. However, this does not imply that the individual departments at the Central and State levels are not required to effectively monitor and evaluate various programmes being implemented under the adminstrative jurisdiction of individual departments. The effort of the NNBM should be mainly to supplement the other efforts of the administrative departments.

4

Conclusions

The functions of Food and Nutrition Board can be more effectively operationalised with strengthening of expertise and necessary staff. Although the description of functions of the Central Coordination Committee provides wide scope for the integration of various activities, the information base for decision-making should be strengthened by creating a monitoring and evaluation cell. At the State level, monitoring and evaluation cells may have to be formed to deal with operational aspects including implementation and effectiveness of different programmes.

There is an urgent need for surveilance on poverty and periodic quansitative assessment of the type and degree of malnourishment/poverty. Institutional arrangements may have to be made to accomplish this task.

A high-power National Committee on Nutrition is needed with the Prime Minister as Chairman and all Secretaries of all economic Ministries/Departments and those dealing with different nutrition programmes as members so as to ensure effective co-ordination. Alternatively, the National Children's Board (formed in 1974) can take more effective steps in co-ordinating programmes for children which form the main thrust of activities. This would require strengthening of the Board with skilled manpower and organising relevant data-base system for enabling effective decision-making. Constituting a sub-committee which can serve as a Standing Committee of this National Committee would be useful, so that it can meet at preferable frequencies. Therecent inter-ministerial

co-ordination committee formed under the chairmanship of the Member of Planning Commission could possibly serve this purpose, if this can be a permanent institutional arrangement. Similarly, at the State level, Standing Committee on Nutrition with the Chief Minister as the Chairman and Secretaries of concerned Departments as members should be constituted to ensure better co-ordination, with a stipulation that it should meet at least once in three months.

The National Nutrition Monitoring Bureau can play a more useful role by incorporating various surveys and primary data and relating them to socio-economic and institutional parameters so that the efticacy of different programmes can also be tested : and concurrent evaluation could be integrally combined with the monitoring function of the Bureau.

Insututional Aspects of Monitoring : In the long run, creation of monitoring and evaluation organisation within the projects is highly desirable since this would not only provide continued information throughout the life of the project but also provide more direct feebback to the management at significantly lower costs. Although the project managers are not expected to be very familiar with the techniques of monitoring end evaluation, the symbiotic relationship between the project management and the monitoring evaluation unit should be clearly recognised.